

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

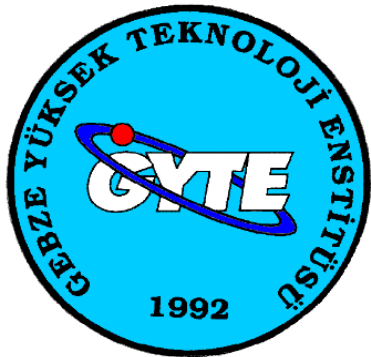
COST Action TD1105

WGs and MC Meeting at ISTANBUL, 3-5 December 2014

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Year 3: 1 July 2014 - 30 June 2015 (*Ongoing Action*)

Metal Functionalization of ZnO Nanorods



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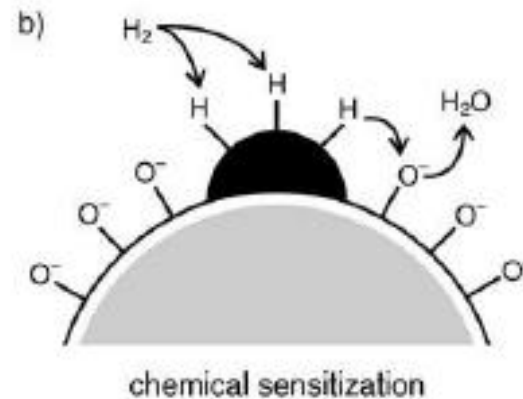
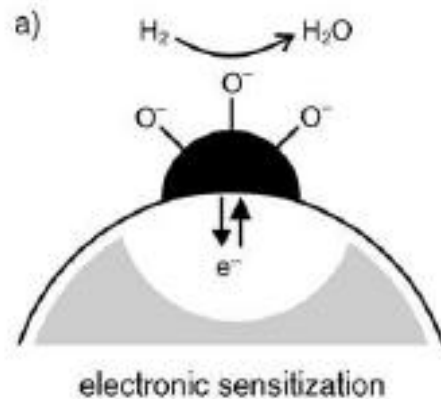
Dept. of Physics

Gebze / TURKEY

 **cost**
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY



Two Sensitization Mechanism by Metal or Metal Oxide Additives:

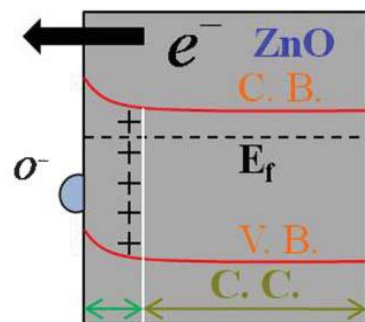


The additive is an acceptor with captured free electrons from the host surface and then release those electrons back to the surface upon reaction with the incoming gas

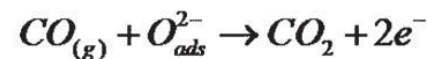
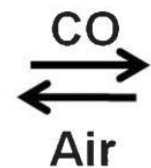
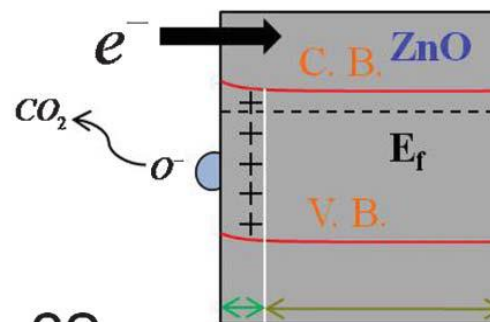
Chemical sensitization by the spill over and replacement of the incoming gas and change of the surface oxygen concentration

Chemical Sensitization

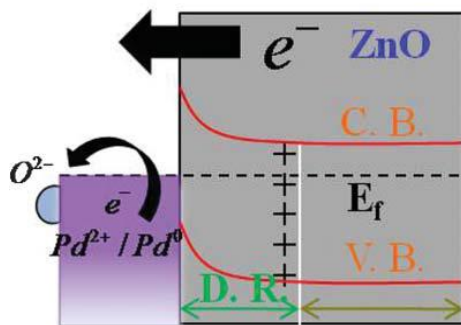
(a)



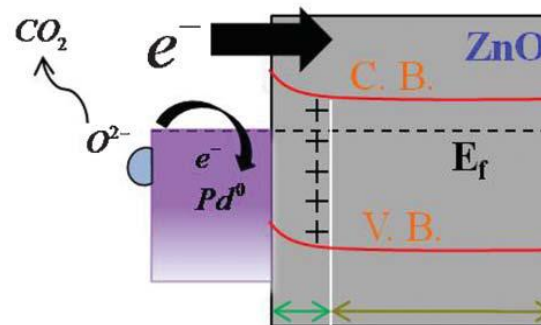
Depletion region



(b)



Conduction channel



Schematic representation of band bending in the near surface region n-type semiconductor induced by partially filled donor state of an absorbed molecule

Different Configurations of the electrodes

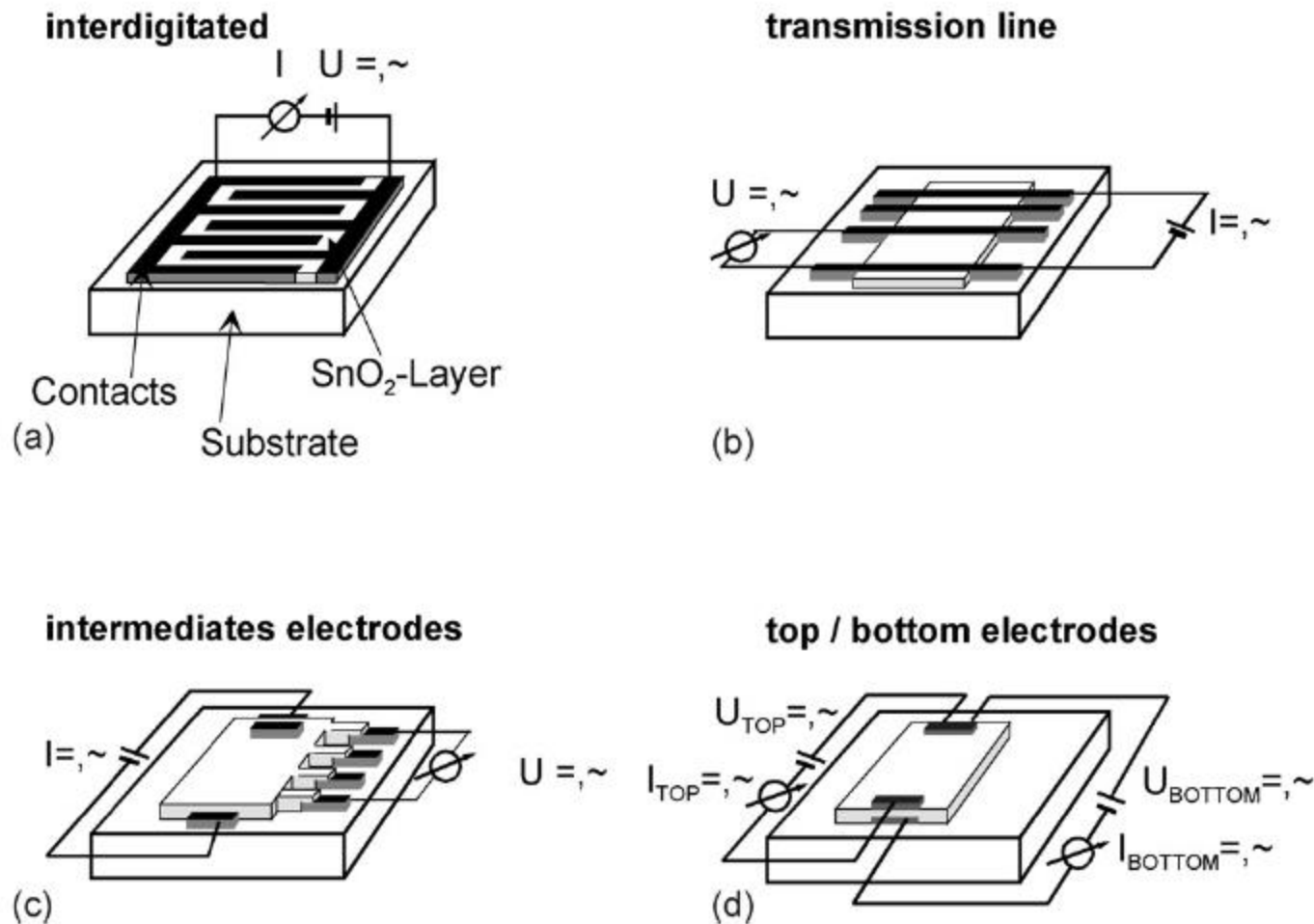


Fig. 4. Different configurations of the electrodes.

Different conduction mechanism

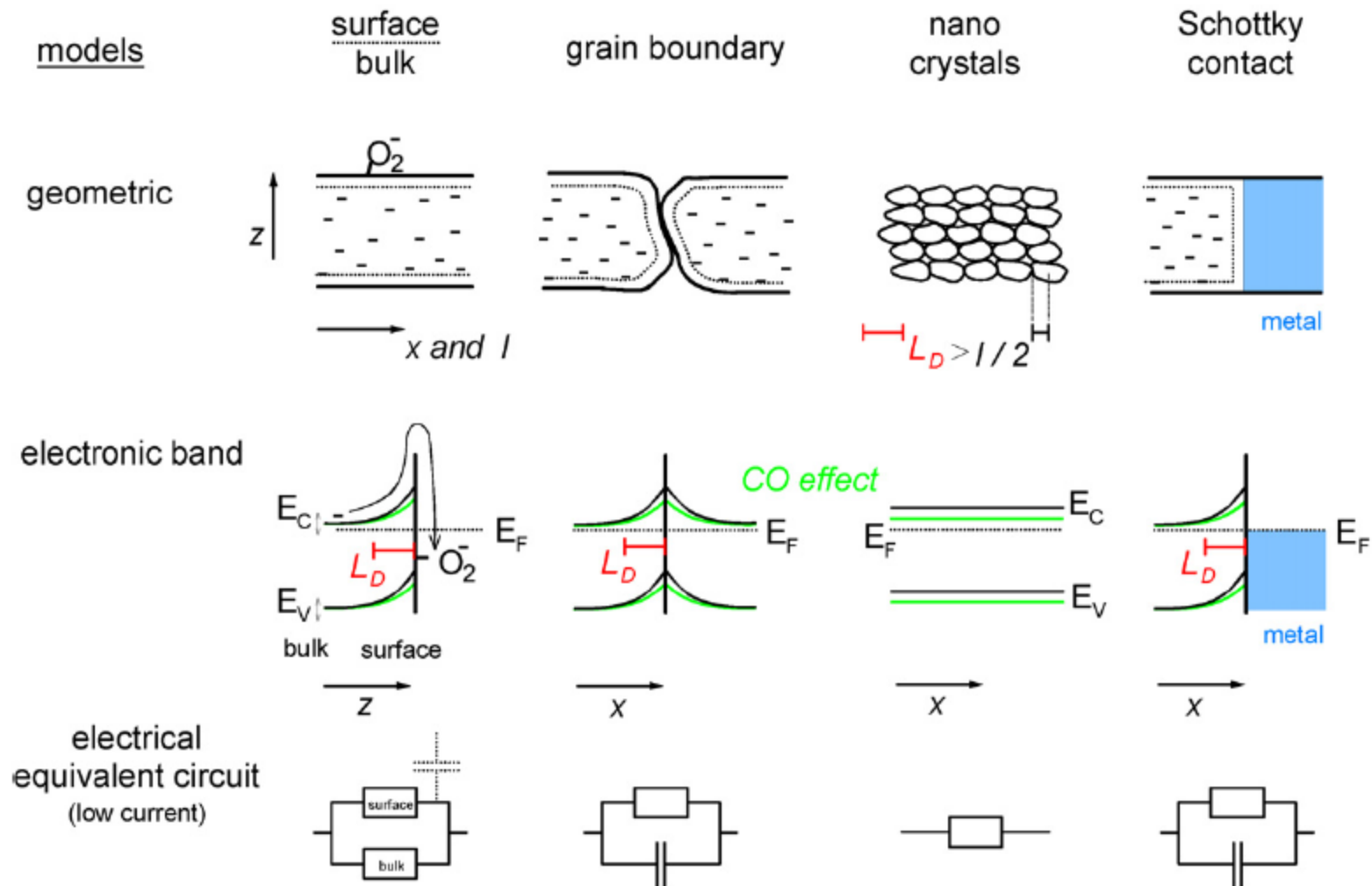
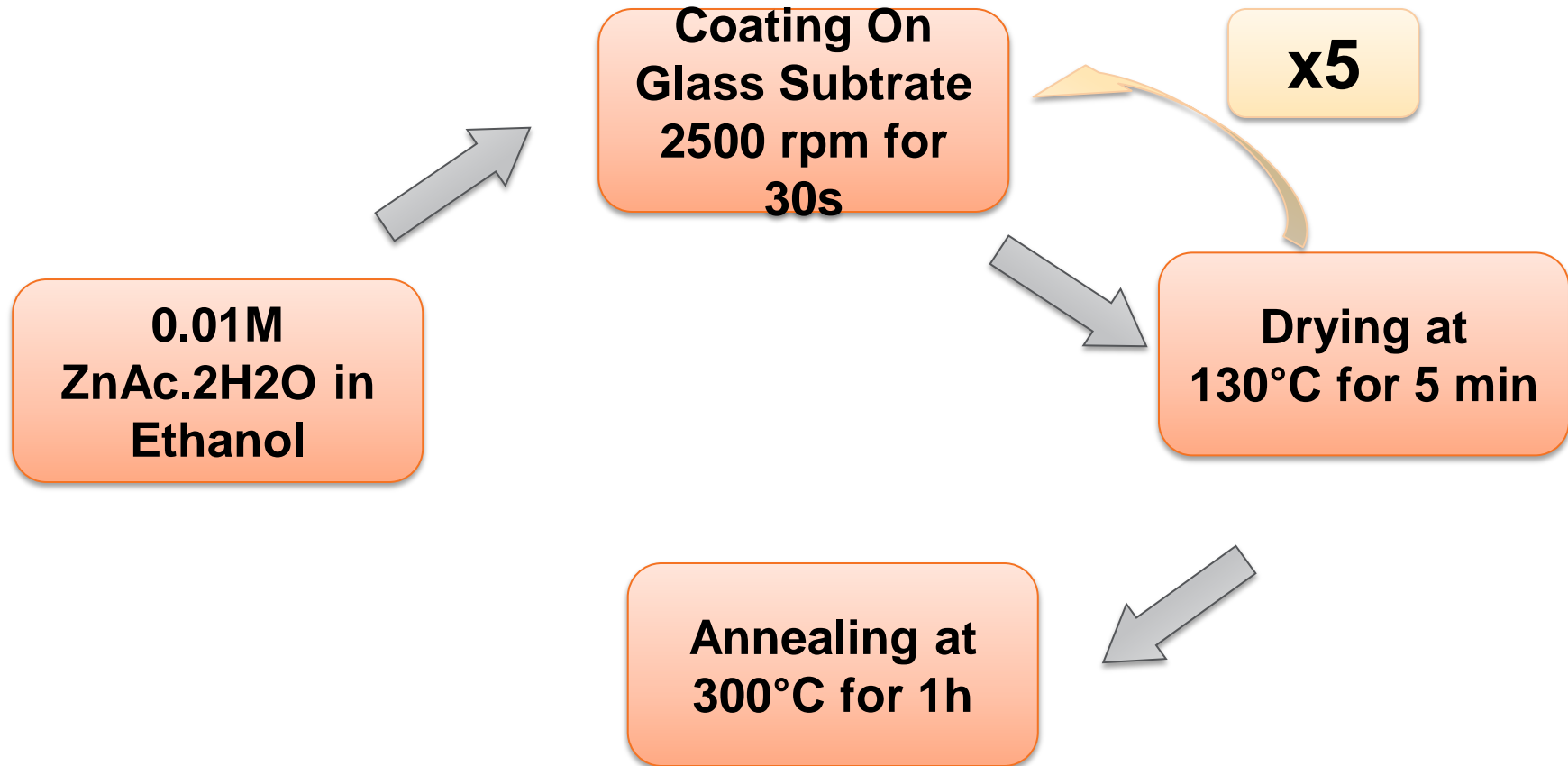


Fig. 6. Different conduction mechanisms and changes upon O₂ and CO exposure to a sensing layer in overview. This survey shows geometries, electronic band pictures and equivalent circuits. E_C minimum of the conduction band; E_V maximum of the valence band; E_F Fermi level; L_D Debye length. For details see [2].

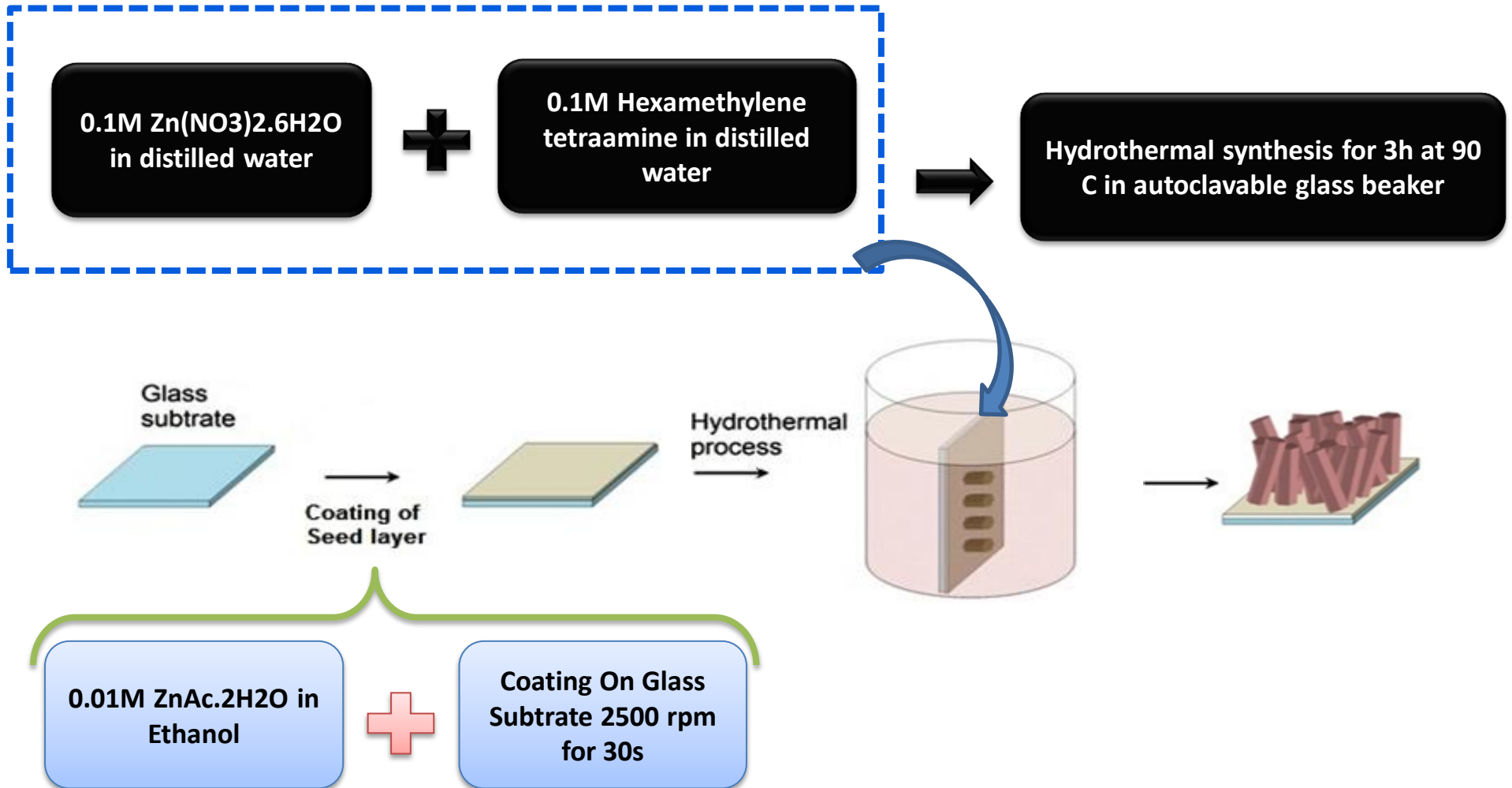
Fabrication of ZnO Nanorods

- Coating of ZnO seed layer



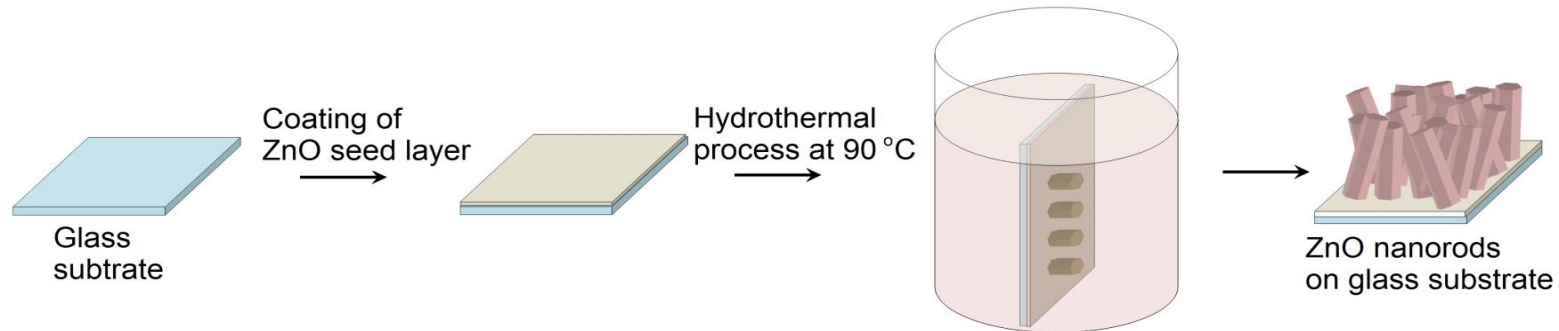
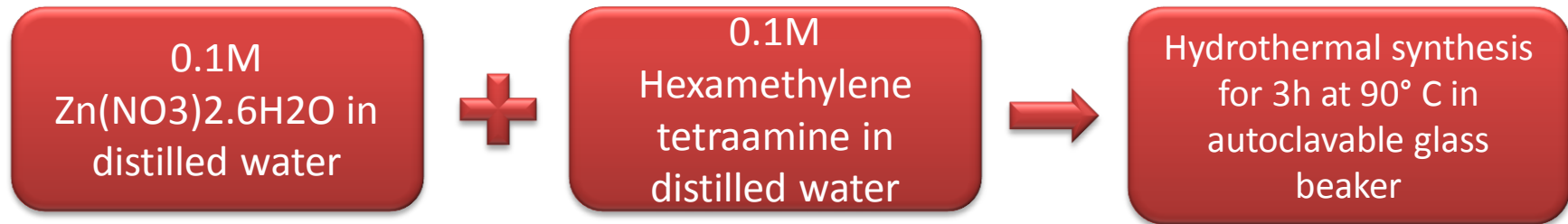
EXPERIMENTAL

- Fabrication of ZnO Nanorods*



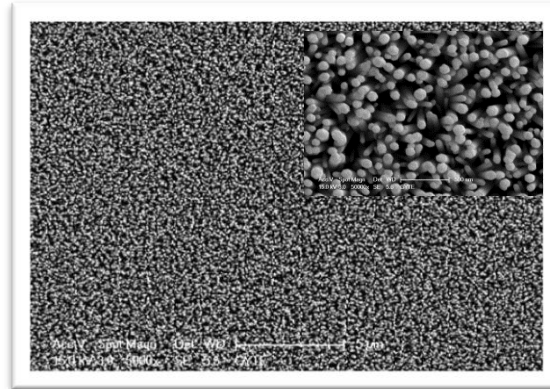
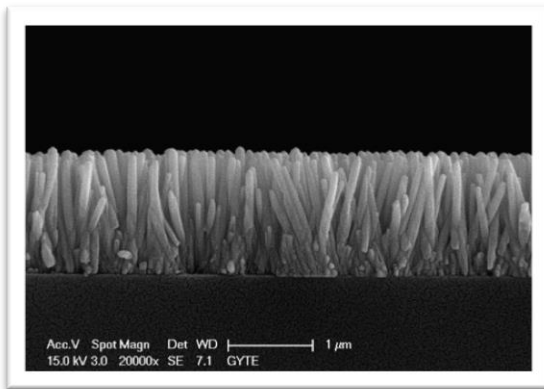
Hydrothermal Synthesis

- Synthesis ZnO nanorods on seed layer coated glass substrate

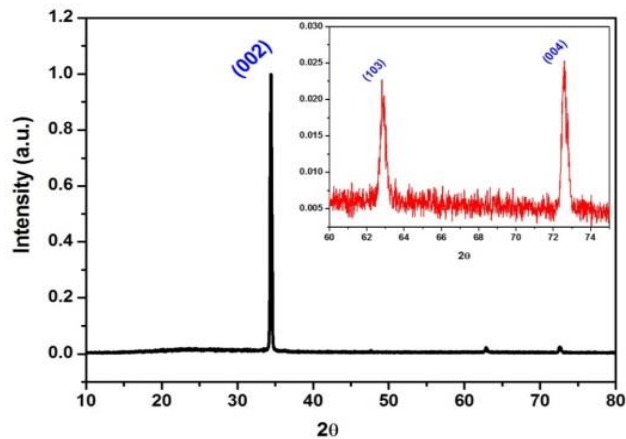


ZnO nanorods; hydrothermal process

- SEM & XRD



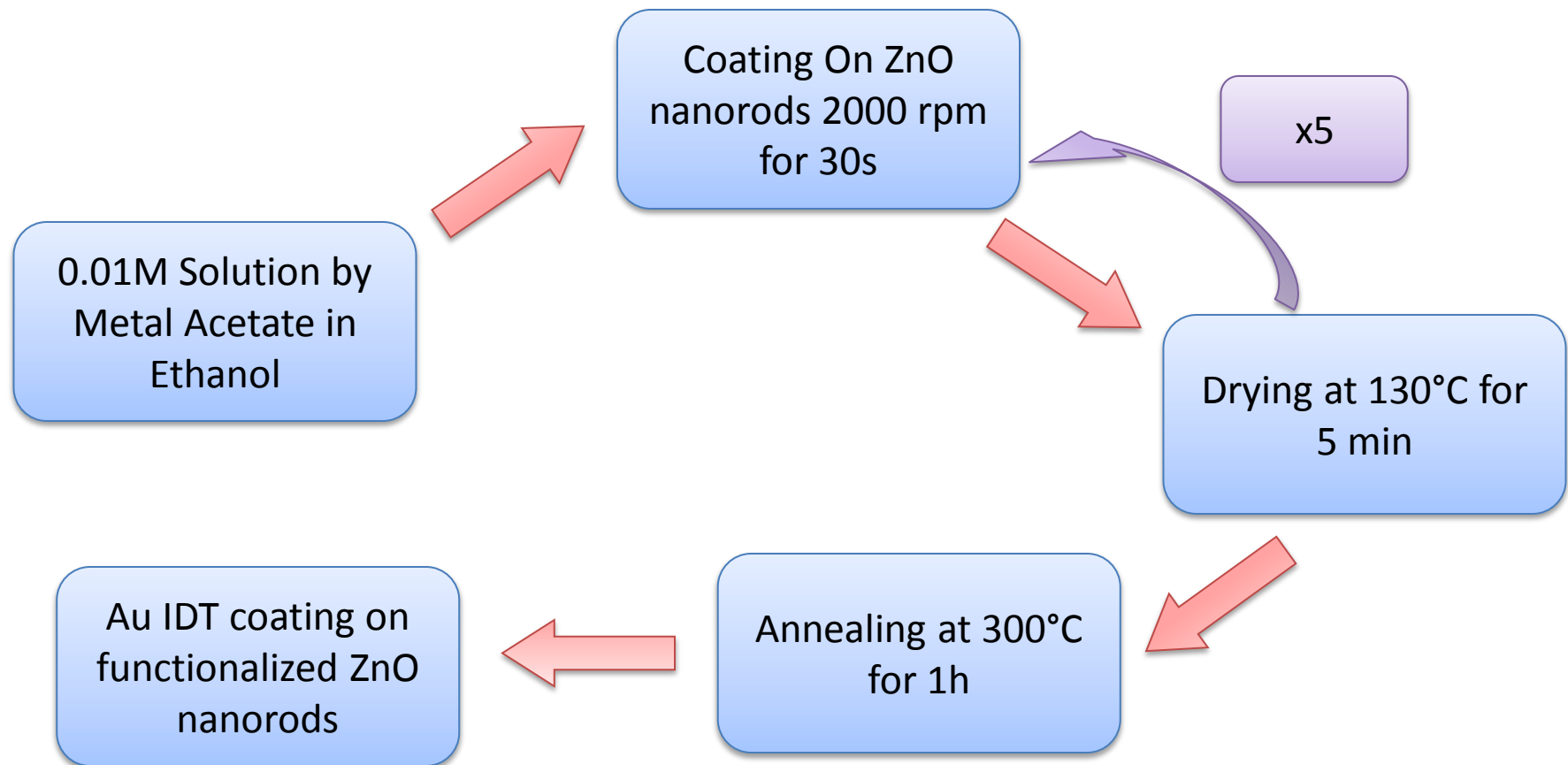
- ❖ 100 nm in diameters
- ❖ 1.5 μm in length
- ❖ C axis



- ❖ Single Crystal
- ❖ Wurtzite Structure

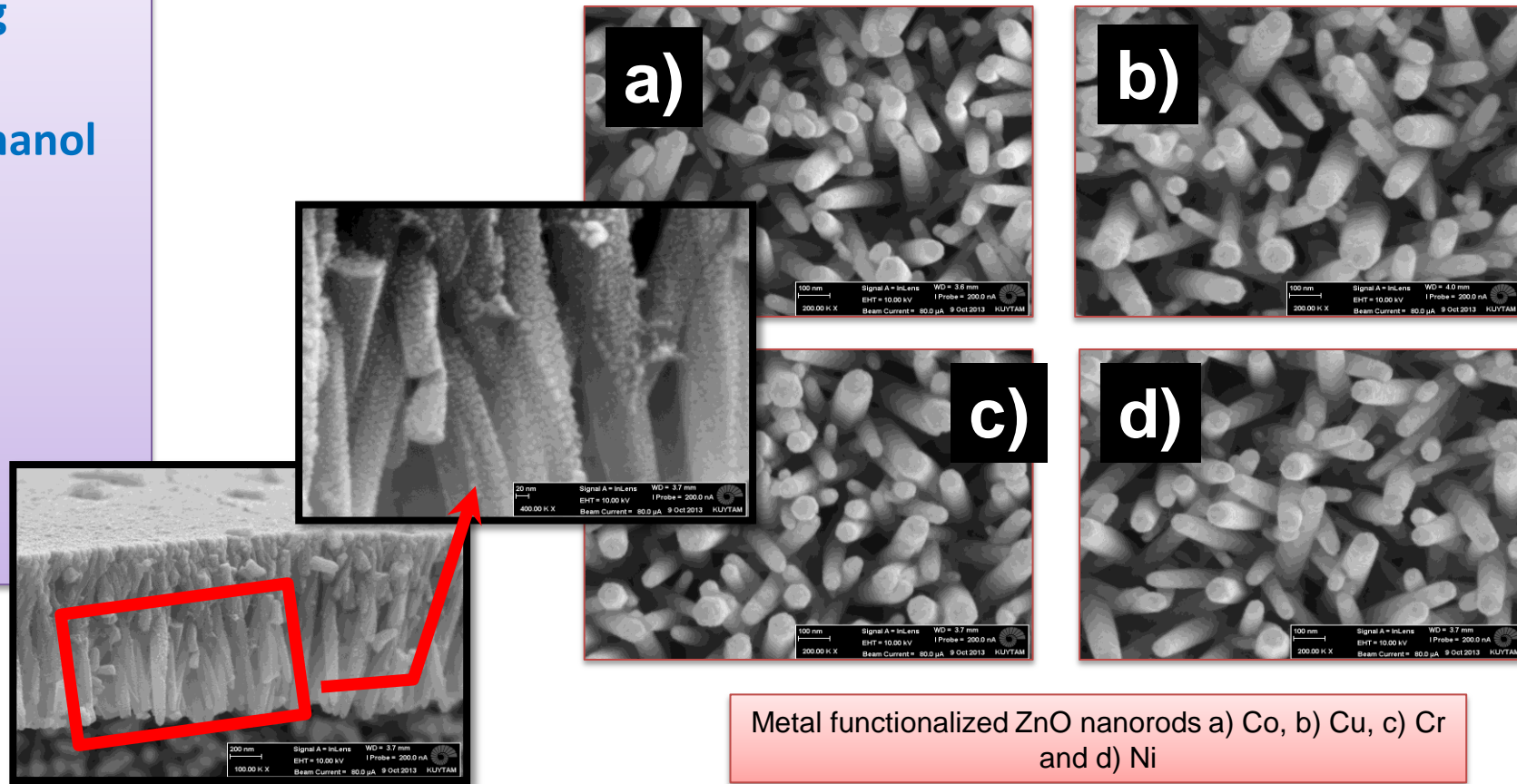
Functionalization of ZnO nanorods

- Sol-gel Process



Metal Funtionalized ZnO nanorods

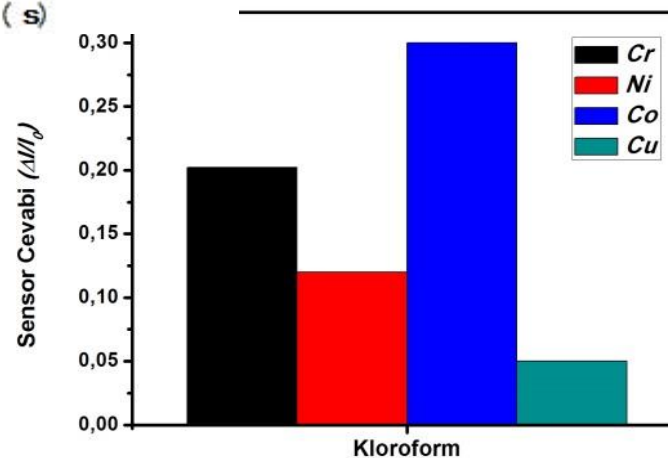
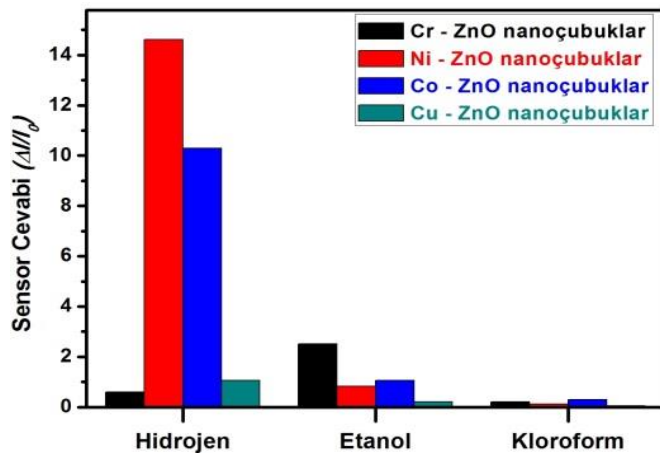
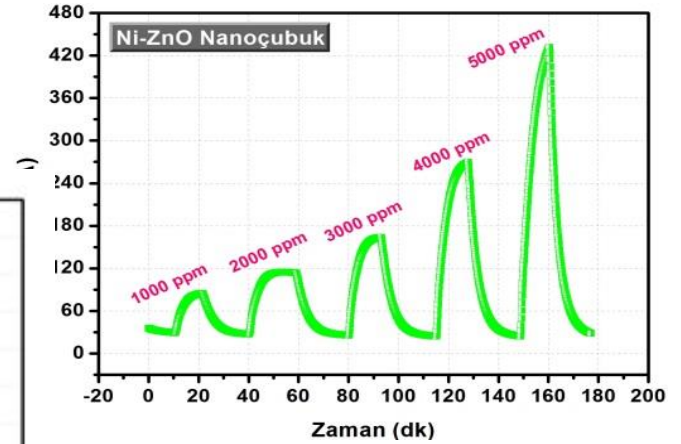
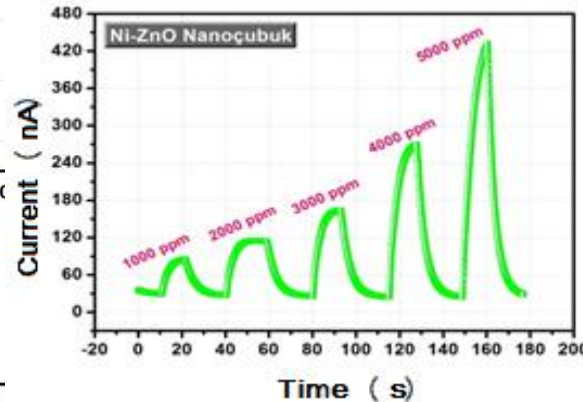
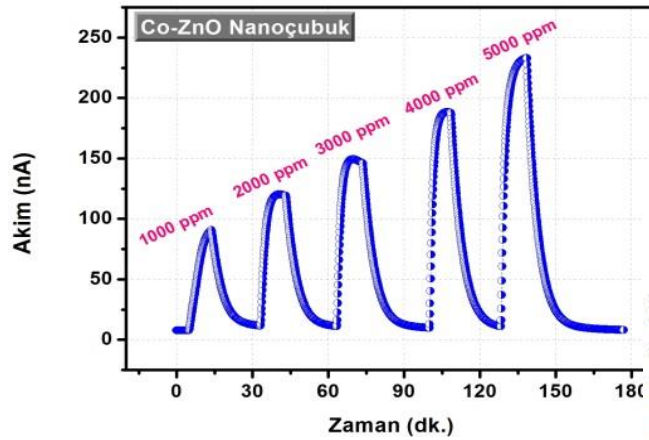
- Sol-gel process & spin coating
- 0.001M lık Acetate+Ethanol Solution
- Cr
- Ni
- Co
- Ni



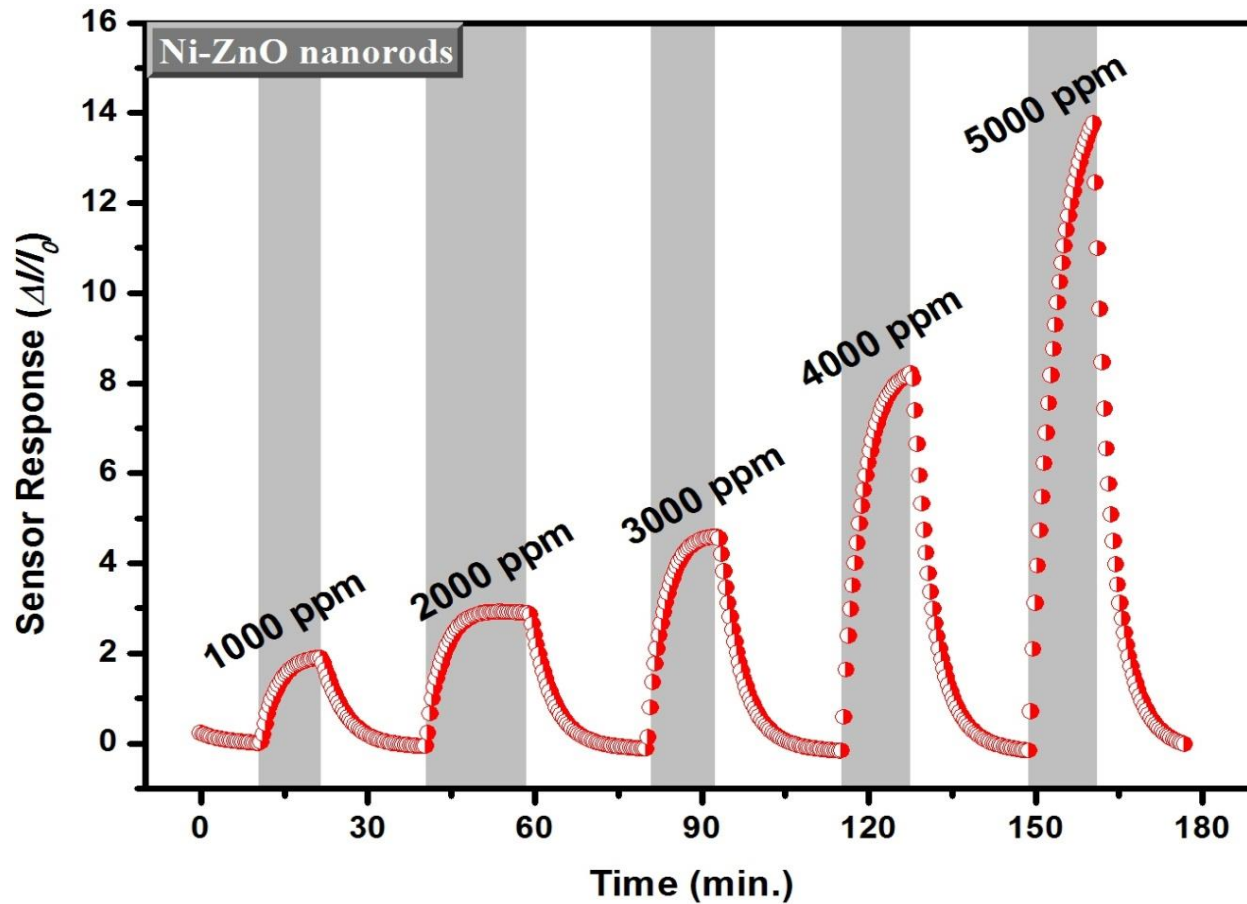
Metal functionalized ZnO nanorods a) Co, b) Cu, c) Cr and d) Ni

SEM image of Cr functionalized ZnO nanorods

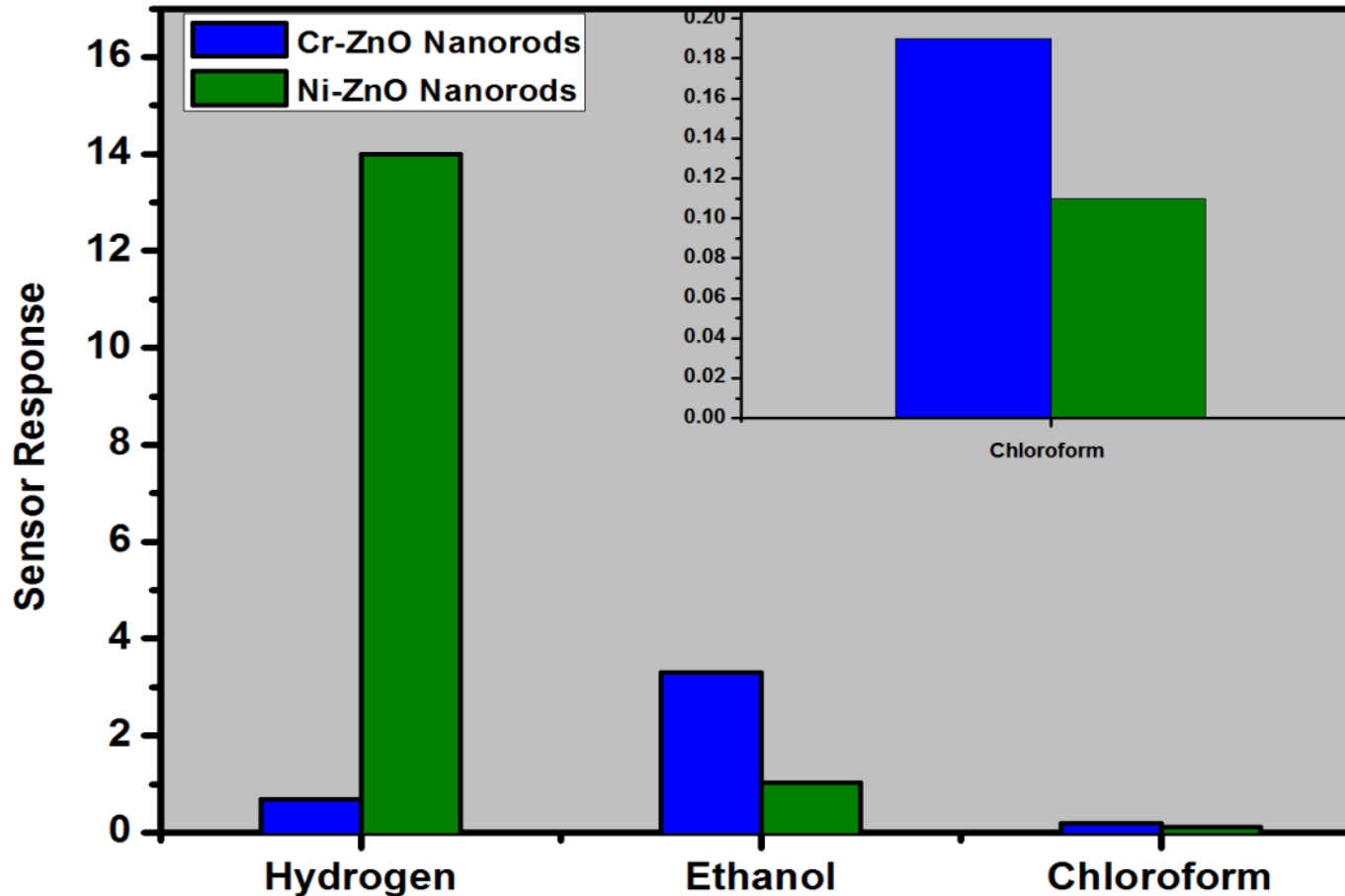
Metal Nanoparticle/ZnO Nanorods Sensor Responses



H₂ responses of Ni Functionalized ZnO Nanorods at 200°C



Sensor Responses of Cr and Ni Functionalized ZnO Nanorods



- H₂, Ethanol and Chloroform responses at 200°C and concentration is 5000 ppm