# Surface morphology and optical properties of ZnMeO ( Me: Co, Ni ) thin films prepared by RF - sputtering

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## MOTIVATION

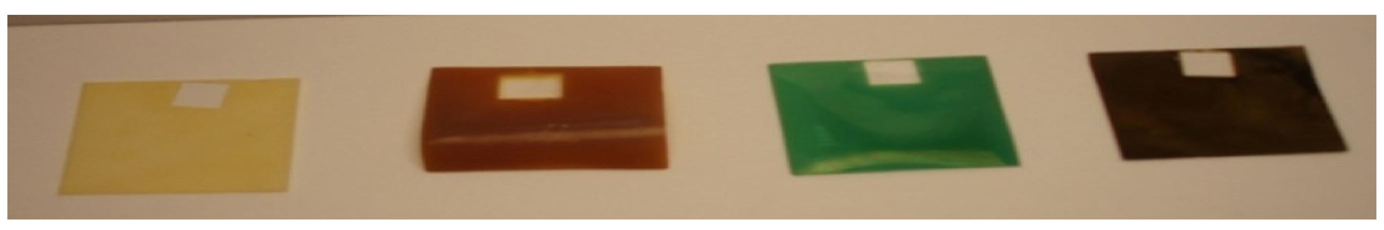
Zinc oxide (ZnO) based materials demonstrate attractive properties for different modern technological applications. ZnO has advantages as it is a transparent direct wide band gap semiconductor with a large exciton binding energy. In addition, it was found good gas sensing properties of zinc oxide for detection of harmful and toxic gases. Transition metal doping was proposed to apply as the promise way to enhance the gas sensor sensitivity.

The present work is devoted to preparing of ZnMeO (Me: Co, Ni) thin films by RF-plasma sputtering technique and study of their structural and optical properties depending on content of cobalt and nickel.

## SAMPLES

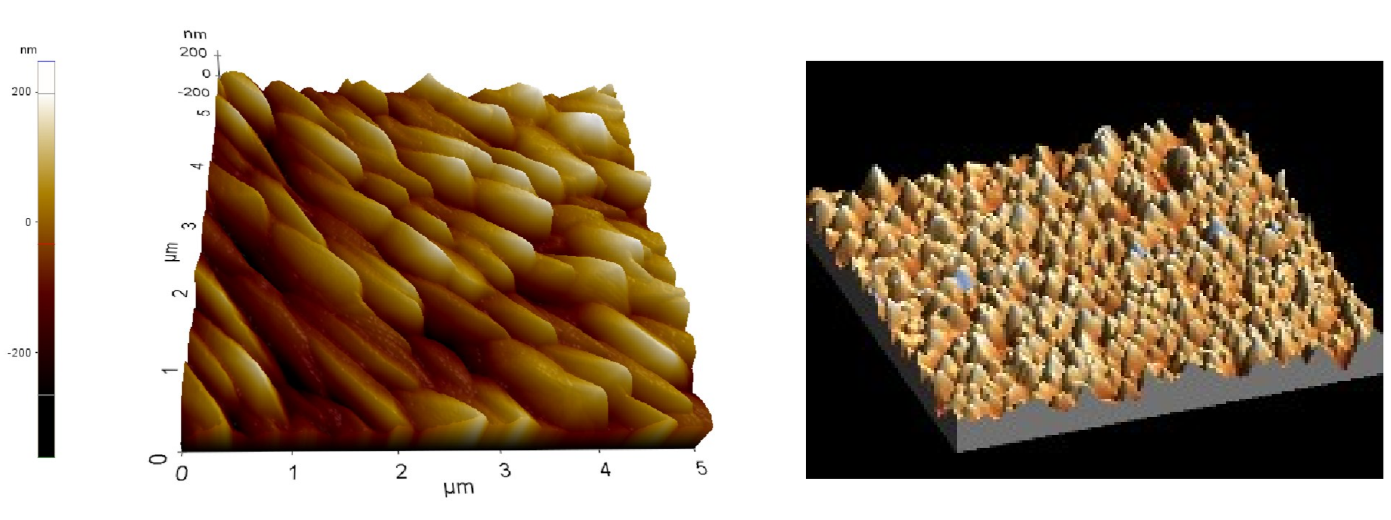
The $Zn_{1-x}Co_xO$ and $Zn_{1-x}Ni_xO$ thin films were prepared by RF reactive sputtering technique. Content of transition metals in the deposited films has varied in range of 0 – 10 %. X-ray diffraction (XRD), transmission electron microscopy (TEM) and atomic force microscopy (AFM) were main techniques for structural and morphological analysis of the fabricated samples.

The UV-vis spectra of the thin films were recorded using grating spectrometer for spectral range of (200-2200) nm. This setup has also served to register photoluminescence (PL) spectra. For such kind of measurements the samples were excited using a 325 nm He-Cd laser with an excitation intensity value of 10 mW.



ZnO $Zn_{0,96}Mn_{0,04}O$ $Zn_{0,96}Co_{0,04}O$ $Zn_{0,96}Ni_{0,04}O$

Fig. 1. Photo images of ZnMeO (Me: Co, Ni) thin films

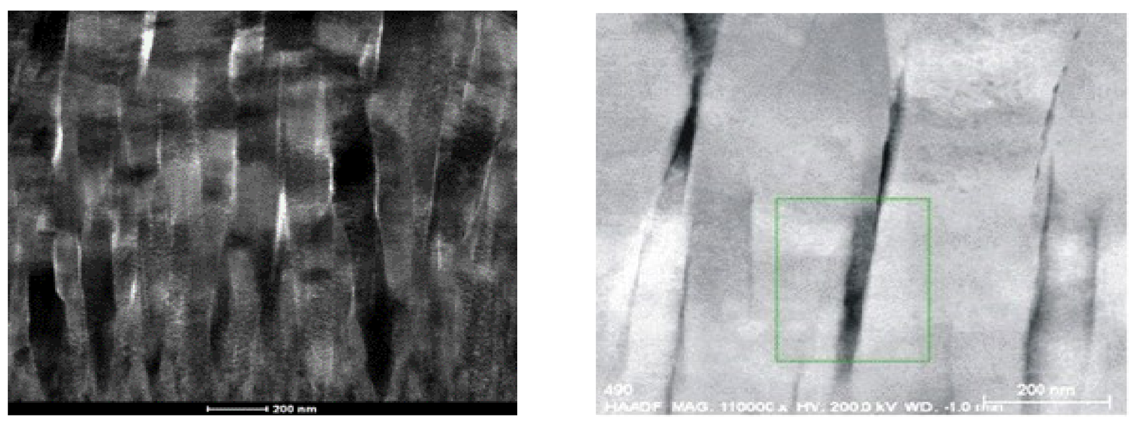


a) b)

Fig.2. 3D AFM images of the $Zn_{1-x}Co_xO$ (a) and $Zn_{1-x}Ni_xO$ (b) thin films

## MAIN RESULT

According to HR-TEM and AFM analysis the ZnCoO thin films are composed of closely packed nanocrystallites with nanorod shape, whereas the ZnNiO thin films show uniform columnar microstructure. The shift of the absorption edge due to decrease the energy band gap Eg with increasing cobalt content and complex dependence of the energy band gap on content of nickel was observed in optical absorption spectra of the studied films. The observed two photoluminescence peaks are attributed to near band gap emission and vacancy or defect states.



a) b)

Fig. 3. HR TEM images of $Zn_{1-x}Ni_xO$ thin films: a) STEM BF , b) STEM HAADF (Z- kontrast)

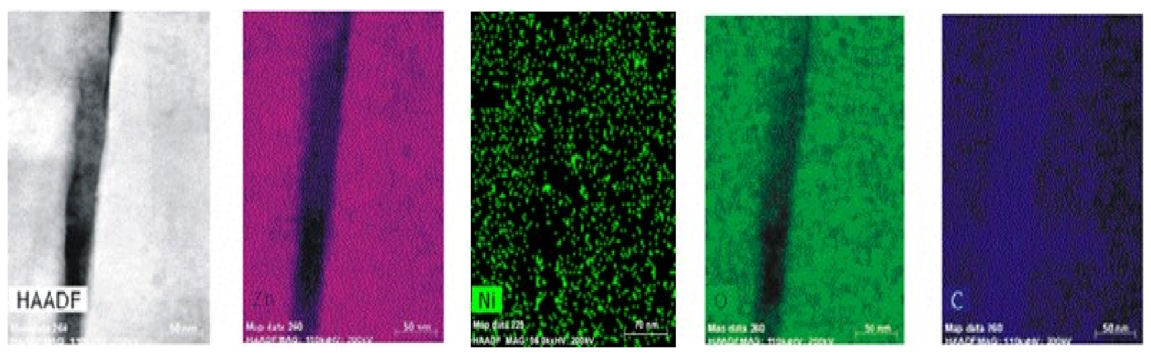



Fig. 4. EDS maps from fig. 3

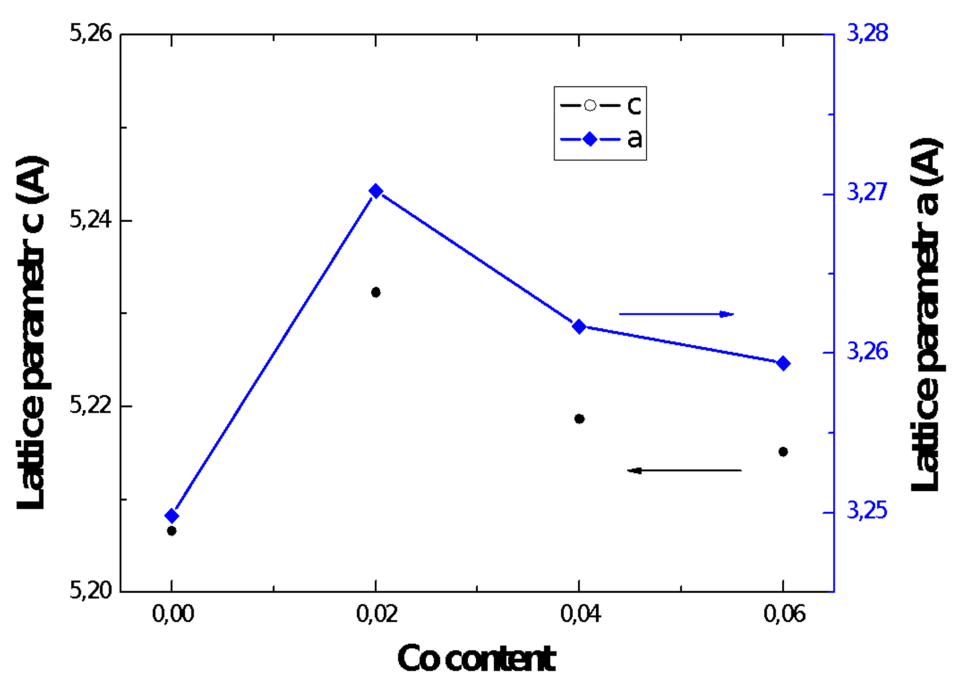



Fig. 5. Dependence of lattice parameter on Co content in $Zn_{1-x}Co_xO$ thin films

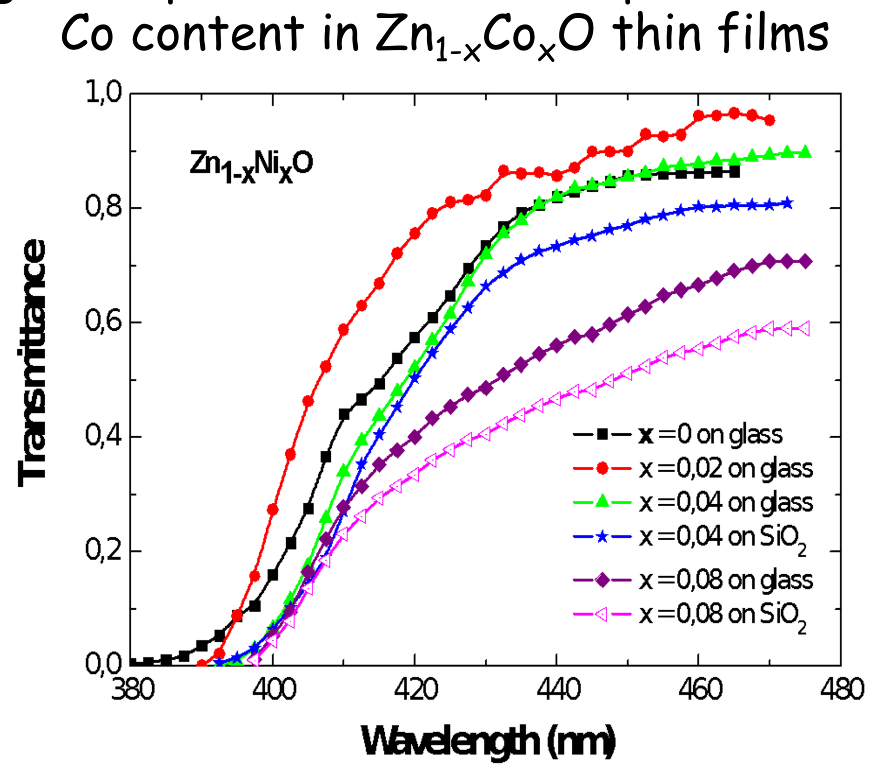



Fig. 6. Transmittance spectra of $Zn_{1-x}Ni_xO$ thin films on different substrates at room temperature

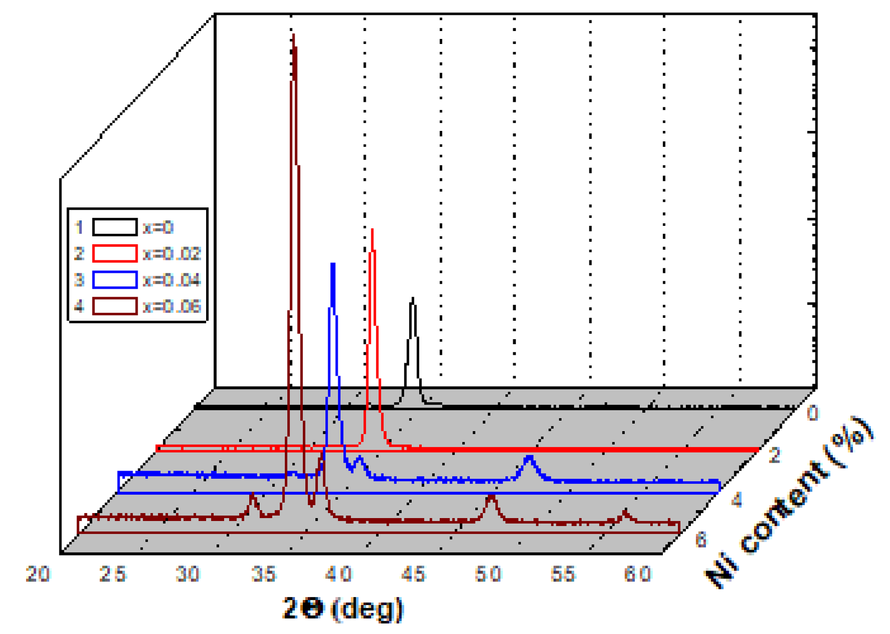



Fig. 7. X-ray diffraction spectra of Ni doped ZnO thin films with various doping level

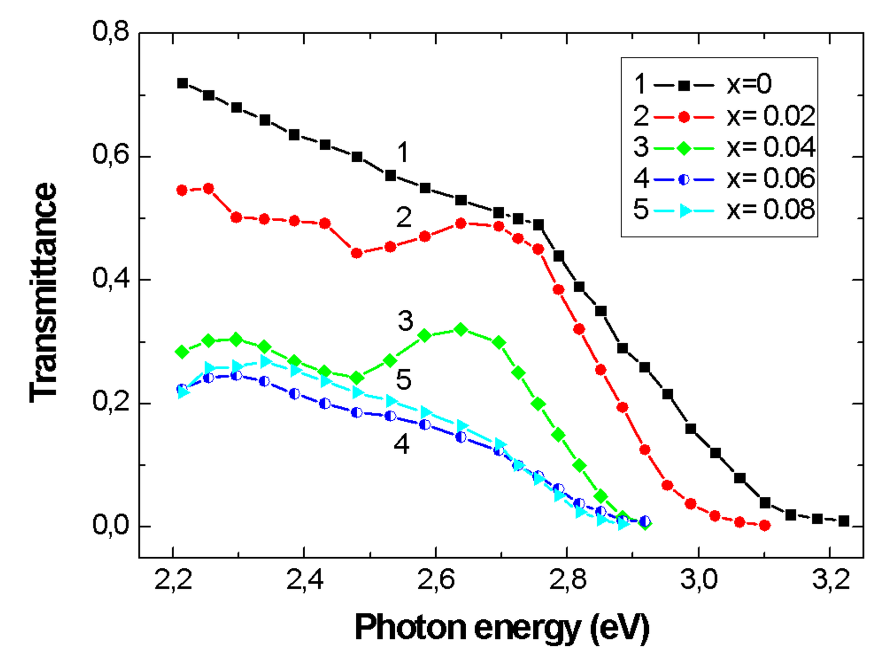



Fig.8 Transmittance spectra of $Zn_{1-x}Co_xO$ thin films on different substrates at room temperature

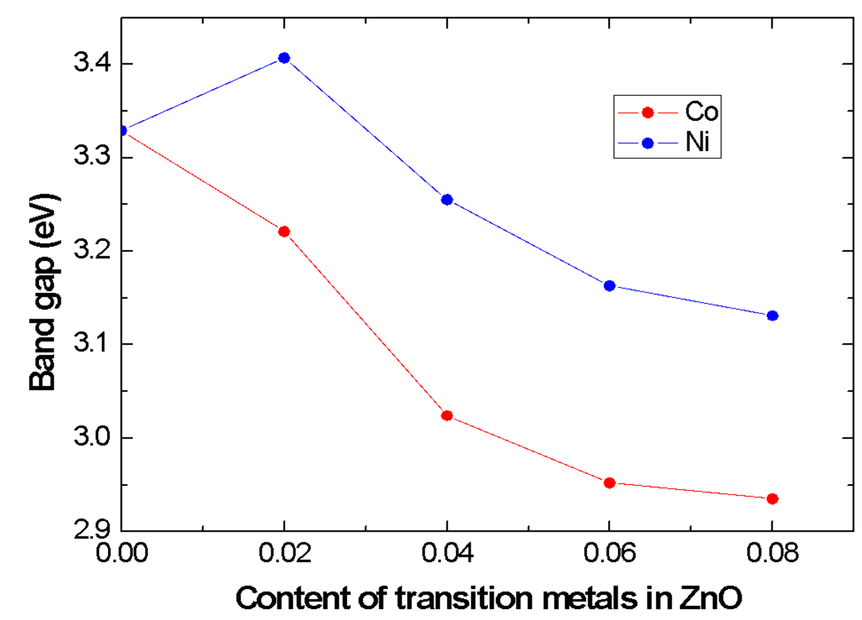



Fig. 9. The energy band gap of $Zn_{1-x}Me_xO$ thin films as a function of Co and Ni- content.

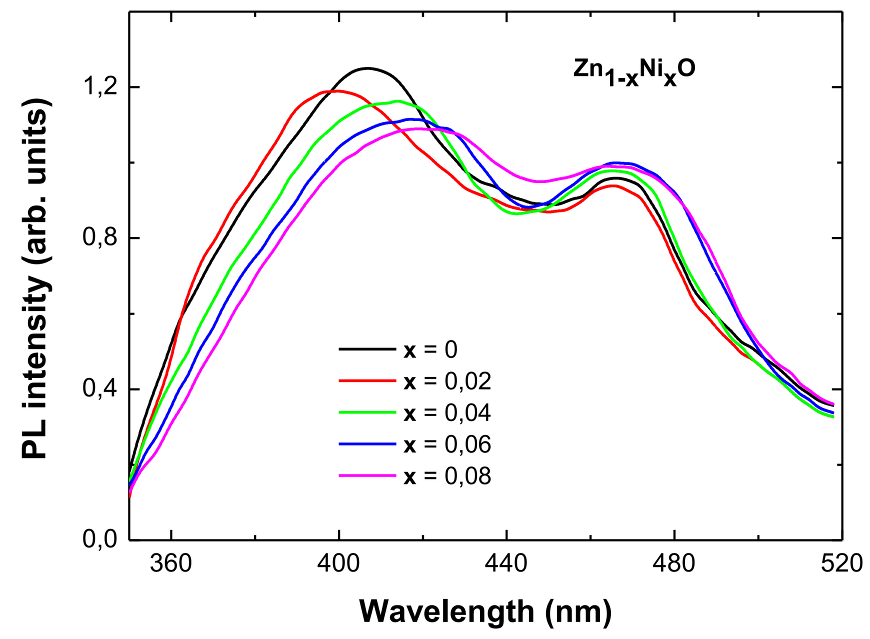



Fig.10. PL spectra of $Zn_{1-x}Ni_xO$ thin films

## ACKNOWLEDGMENTS

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