World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:10, No:06, 2016

# An Investigation of the Structural and Microstructural Properties of Zn1-xCoxO Thin Films Applied as Gas Sensors

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**Abstract :** Zinc oxide (ZnO) pure or doped are one of the most promising metal oxide semiconductors for gas sensing applications due to the well-known high surface-to-volume area and surface conductivity. It was shown that ZnO is an excellent gas-sensing material for different gases such as CO, O2, NO2 and ethanol. In this context, pure and doped ZnO exhibiting different morphologies and a high surface/volume ratio can be a good option regarding the limitations of the current commercial sensors. Different studies showed that the sensitivity of metal-doped ZnO (e.g. Co, Fe, Mn,) enhanced its gas sensing properties. Motivated by these considerations, the aim of this study consisted on the investigation of the role of Co ions on structural, morphological and the gas sensing properties of nanostructured ZnO samples. ZnO and Zn1-xCoxO (0 < x < 5 wt%) thin films were obtained via the polymeric precursor method. The sensitivity, selectivity, response time and long-term stability gas sensing properties were investigated when the sample was exposed to a different concentration range of ozone (O3) at different working temperatures. The gas sensing property was probed by electrical resistance measurements. The long and short-range order structure around Zn and Co atoms were investigated by X-ray diffraction and X-ray absorption spectroscopy. X-ray photoelectron spectroscopy measurement was performed in order to identify the elements present on the film surface as well as to determine the sample composition. Microstructural characteristics of the films were analyzed by a field-emission scanning electron microscope (FE-SEM). Zn1-xCoxO XRD patterns were indexed to the wurtzite ZnO structure and any second phase was observed even at a higher cobalt content. Co-K edge XANES spectra revealed the predominance of Co2+ ions. XPS characterization revealed that Co-doped ZnO samples possessed a higher percentage of oxygen vacancies than the ZnO samples, which also contributed to their excellent gas sensing performance. Gas sensor measurements pointed out that ZnO and Co-doped ZnO samples exhibit a good gas sensing performance concerning the reproducibility and a fast response time (around 10 s). Furthermore, the Co addition contributed to reduce the working temperature for ozone detection and improve the selective sensing properties.

**Keywords :** cobalt-doped ZnO, nanostructured, ozone gas sensor, polymeric precursor method
**Conference Title :** ICCS 2016 : International Conference on Chemical Sensors
**Conference Location :** San Francisco, United States
**Conference Dates :** June 09-10, 2016