Ozone gas sensing on $\text{Zn}_{0.95}\text{Co}_{0.05}\text{O}$ thin films grown by spray pyrolysis

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Zinc oxide based thin films are strategic systems for high power electronics and transparent electrodes due to its wide bandgap. Nowadays metal transition (MT) doping becomes interesting to introduce magnetic properties and cobalt-doped ZnO have been recognized as a promising material in the field of spintronics as diluted magnetic semiconductors (DMS). Recently ZnCoO nanostructured films were employed as gas sensors due to its chemical sensitivity to harmful gases as ozone (O_3). Electrical measurements showed an enhancement on sensor resistance in the presence of Co even at low levels concentrations. However the doping processes in oxides are strongly dependent on synthesis method. One of versatile production method to be explored is the spray pyrolysis. This method has as advantages its low cost and large scale industrial production possibilities when considered as an alternative route to produce thin oxide films.

Our work shows the investigation of cobalt-doped ZnO films grown by pulverization of a solution consisting of zinc acetate dihydrate and cobalt acetate in distilled water. The solution with molarity $M=4 \times 10^{-3}$ allow us the growth of films on silicon substrates at the temperature range 220-300°C. The structural properties of films of $\text{Zn}_{0.95}\text{Co}_{0.05}\text{O}$ with three different thicknesses were investigated by X-rays diffraction (XRD) and scanning electron microscopy (SEM). ZnCoO films grown on (001) silicon substrates present wurtzite phase with high directional preference for the (002) direction as compared to films grown on amorphous glass substrates. Crystallite size varied in the range between 15-25nm, increasing as thickness increases. The electrical response to ozone was measured into a chamber which allowed the control of the substrate temperature and ozone concentrations. The response was considered as the ratio between the electrical resistance when the device is exposed to an ozone content air flux and pure air at temperatures above 200°C. The response of devices for thicker film (~400 nm) was around 2 for 260 ppb of O_3 while a high response is achieved for thinner film (~50 nm) at the same O_3 concentration. Considerations about the electrical resistance and the role of thicknesses are discussed.

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