



A Study of Tin Oxide Structure and Deposition under sol-gel Approach

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Abstract: ZnO is having its high importance in different application areas because of its semiconducting properties. The property based analysis of ZnO is here presented under the structural analysis as well as parametric analysis. The structure of ZnO and its characteristics are under the influence of temperature and pressure parameters. In this paper, the characteristic optimization of ZnO thin film is defined using sol-gel approach.

Keywords: ZnO Thin Film, Sol-gel, pressure, temperature

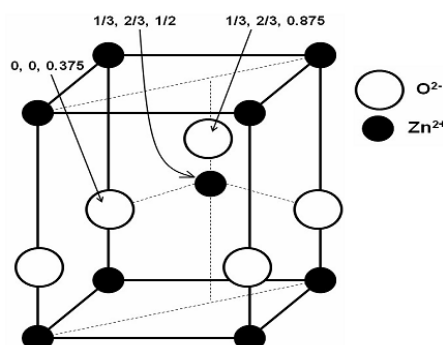
Introduction

With the increasing demand of semiconductor devices, the new evaluation was performed where the creation of material processing was performed using the technology and the electronics. There are number of material are available under the semiconductor families. One of such material comes under the composition is Zinc Oxide. Zinc Oxide is presented as the semiconductor materials that satisfy the most properties required in a material by the world. These requirements include the higher electron mobility, larger band gap and the strength of breakdown field. Because of these materialistic and environmental characteristics, it provides the extensive support with some different application and devices such as sensor devices, UV electronics etc. Zinc oxide is also having its role in polycrystalline form. In this form, it is used in vast range of applications such as for medical treatments. Later on the work on the optimization under different growth parameters is defined to improve the quality.

A. Structure of ZnO

ZnO crystallized form is present in tow main forms called cubic zic blende and the hexagonal surtzite. This hexagonal cell structure is shown in figure 1. These structures of the zinc are optimized under different parameters that mainly include temperature and pressure. In the hexogen form it is defined in closed packed lattice form. In this form, the interconnection between two interconnecting lattices exist called zn2 and o2. There are different form of ZnO that are defined under the periodic linear combination of atomic theory. The structural form of ZnO is also defined in terms of different planes derive alternatively from the ions of these two. The opposite charge on these ions returns the positive charge as well as negative charge polar surfaces. It also includes the structural definition so that the defect avoidance will be there. The excess atoms are defined as the tendency to provide the functional analysis on the donor interstitials

Figure 1: Cell Structure of ZnO



B. ZnO characterization using sol-gel

Zinc oxide characterization can be performed under different approaches including the chemical bath, electrochemical and sol-gel spin techniques. Out of these, sol-gel is one of the most promising approach that gives the simplified fabrication route under the ZnO layers. It also includes the deposition of the equipment so that the vapor phase will be eliminated from the process model. To fabricate the ZnO thin films sol-gel is being adapted as an inexpensive alternative. The sol-gel fabrication is defined an adaptive procedure so that ZnO construction for the thin film is comparative simple and low cost. It also includes the relatively extensive approach so that the cost effective sol-gel will be identified. There are different coating techniques integrative used by sol-gel itself so that the optimization of the ZnO film growth will be obtained. It also gives the growth estimation of ZnO films so that the simplicity will be achieved extensively over the ZnO.

The process formed by sol-gel is correlated with ZnO properties under different parameters. These parameters can be materialistic or environmental. The main parameters analyzed under sol-gel process are the temperature and the pressure. It also include the effective analysis for the optimization of structural and optical property analysis so that sol-gel spin coated film will be attained and discussed.

The presented paper is the experimental study of ZnO, its structure and characterization approaches. In this section the detail view about the ZnO structure and its characterization is defined under different parameters. In section II, the work already has done in the area of ZnO parametric analysis and its optimization approaches. In section III, the experimental investigation is performed on sol-gel approach for the characterization of ZnO film. In section IV, the conclusion obtained from the work is discussed.

Literature Study

Lot of work is already done on metal oxide gas sensor analysis and its characteristic exploration. This exploration is performed by different researchers in different ways. Here in this section, the work done by some earlier author on the characteristic exploration of Zinc-Oxide Thin Film using Sol Gel technique is proposed. N. Barsan has presented a study on the generalized exploration of Metal Oxide Gas Sensors. Author presented a review study under different experimental techniques so that the gas sensors based on the semiconducting metal oxide is defined. Author presented the assessment on the subsequent modelling of gas sensors. Author defined some phenomenological and spectroscopic approaches under the realistic environments so that the shortcoming and the achievements of different experiments will be obtained [1]. Another work on the thin film gas sensor done by G.Sberveglieri. Author defined a critical review on the material used in the gas sensor. Author categorized the gas sensors in two categories under the material analysis. The first category is of oxygen with surface conductance and second is the materials that detect oxidizing and gas reduction in air. Author did the property based analysis on different sensor materials such as tin oxide etc. Author also defined an approach for the thin film growing called rheotaxial growth and sensor oxidation. Author defined this technique with mixed oxide thin film under the high surface analysis with nano size crystal. The main objective of the work was to present the valid utilization of the thin film material under different measure techniques and parameters[2]. Another analytical work on the effect of tin oxide and zinc oxide was presented by S.Hegedus. Author defined the analytical study on the material based properties and its effect. Author study the effect under Silicon Solar Cells. Author defined an optoelectronic and structural property analysis under different films. Author defined the analysis of the work under different vectors including the stability, deposition time and the usage[3].

In year 2009, Daniel P. Heineck has presented an enhancement over the Zinc Tin oxide based thin film transistor. Author defined the fabrication process so that the enhancement over the zinc tin oxide based inverter. Author has presented the enhancement and the depletion mode based estimation under the bottom gate analysis. Author also presented the post deposition based annealing so that the gain over the voltage is obtained [4]. Michal Byrczek presented an investigation on the Zinc oxide growth under the coated glass substrate. Author defined the crytalistic fabrication so that the chemical bath under low temperature is performed. Author defined the crystal growth based experimentation so that the electron scanning under microscoping analysis is performed. Author also performed the study under the speed of nanoflower growth and explains the cause of nanorods. Author defined the research direction and the quality influence under different vectors. Author defined the work under the heating analyss so that the strong exploration to the system will be performed[5]. Another work in same year was presented by Josh Triska to attain the stability for Zin Tin Oxide Thin Film Transistor. Author defined the layered deposition in this work with gate dielectrics and performs the work under acceptable mobility. Author defined the efforts on the stabilize operations under changing deposition temperature (Al_2O_3), O_2 plasma exposure. Author defined the mapping under the plasma exposure so that the traffic behavior of SiO_2 will be altered. Author defined the trapping behavior so that the reduced instability significantly. Author defined an interface so that the trapping of source will be done[6]. S.Jay Chey has defined the characterization of Indium Tin Oxide under the doped zinc oxide thin film deposition. Author defined the RF magnetron sputter deposition. Author defined the thin film based resistance and optimal transissivity and stability testing conditions. Author defined the doped film deposition using magnetron sputtering system. Author defined sampled biasing under the high temperature conditions and the properties. Author defined the

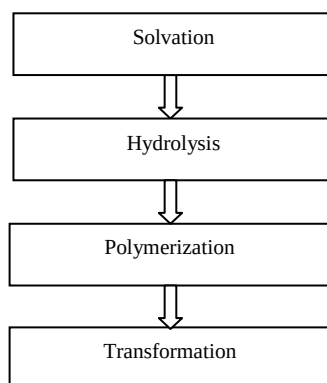
sample bias was applied by RF power to the sample. Author defined the high deposited with argon as the process gas. Author defined the deposition on Zinc Oxide under high temperature. Author defined the comparative analysis on thin film under biased sampling on high temperature process. Author defined the work under the resistance and the transmission. Author also presented the optimal concentration of hydrogen under the sample biasing and high temperature in high deposition conditions[7].

In year 2010, Yong-Hoon Kim defined a thermal annealing process so that Zinc Tin Oxide based transistors and the circuits. Author defined the high performance circuit for zinc-tin-oxide. And thin film transistor. Author defined the electrodes and the thermal treated annealing process. Author defined the thresh holding based current ratio analysis under the ZTO TFT based inverter. Author defined the logic level conservation of the thin oxide[8]. Rongliang has defined a sol gel based method for the high surface based Tin Zinc oxide processing. Author defined the a method for the conductance of the nano particles so that the photocatalytic activity. Author defined the ZnO SnO₂ for the solid solution under the sol gel technique. Author defined the work with low photocatalytic activity so that heat treatment will be obtained under high temperature. Author defined the ZnO process under the nanopartical analysis in specific surface area[9]. Another work on the optical and electrical stability was processed by Pradipta K. Nayak on Zinc Tin Oxide based thin film transistors. Author defined the fabrication study under the sol gel method. Author defined the thresholding voltage based approach to achieve the environmental and optical stability. Author presented a sensitivity to the positive and gegative gate bias stress[10].

Experimental Analysis : A Study

In this present work, the characteristics optimization of ZnO thin film is defined by using sol-gel approach so that the maximum purity intended acetate dehydrate will be obtained. The objective of this experimentation is to use the triethanolamine as the surfactant so that the maximum purity will be obtained. In this experiment, Ethonal and Ammonium hydroxide are considered as the homogeneous components and some value of PH is mixed with the solution so that the stoichiometric solution will be obtained and the Zinc oxide nano particles will be generated. The chemical required for this experimentation includes the water, tea and the ethanol drops that will be taken in continuity so that the homogenous solution will be formed from the experiment. The work also attain the stoichiometry in mind so that the sinc oxide will be prepared from it. It also includes the mix of TEA component in constant quantity with ethanol in a dropwise additive approach. The homogenous solution is keep in the effective temperature for 2-3 hours. Along with this, molar calculation of the zinc oxide will be combined with dihydrated mix by using which the homogenous solutoin is generated. Once the solution is obtained, the addition of ammonium hydroxide is added to it drop wise by providing it continuous heating at high temperature for 20 mins. After that little amount of distil water is added to it, the whole solution is left for 30 mins so that the result formation from the solution will be done. It also includes the watching process for 8-10 times based on which the filtration is performed. The solution is placed in oval at medium temperature of about 95 C for 8 hours.

Figure 2: Sol-Gel Process Stages



The yellow colors is attained form it by placing it at very high temperature of 500 to 900 C. Tin oxide film is been analyzed under the thickness analysis under the active analysis and the cancination techniques. The Sn layer has been under different vectors called O₂ and Ar with effect of environmental and atmospheric constraints. The work includes the atmosphere control on high temperature and the with mix gas environment. The tin oxide layer is fabricated on the substrate so that the reactive current magnetron for the sputtering of tin is processed and identified. This process uses the pure tin as the main target and identifies under the temperature and the pressure vectors. Here figure 2 is showing the basic circuit diagram of SnO₂.

The optimized growth of Zinc oxide from zinc acetate is obtained from sol-gel process under different stages. These stages are defined as the solvation, hydrolysis, polymerization and transformation. These stages are defined

in figure 2. The first stage is about to perform the solvation of acetate dehydrate in ethanol which is followed by hydrolyzed. Late on the removal of the intercalated ions is formed as the polyhymer process so that reaction observation will be done. Finally the transformation of this polymerization hydroxyl complex is converted to ZnO.

Conclusion

In this paper, an exploration is defined for ZnO oxide, its structure and the characteristics optimization approaches. The main concentration is given on the optimization process for the chacterization of the properties using sol-gel approach. In this paper, experiment based study is defined on sol-gel approach for the optimization of ZnO thin film.

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