Band gap and conductivity variations of ZnO nano structured thin films annealed under Vacuum.

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Abstract. Zinc Oxide thin films were prepared by Successive Ionic layer adsorption and reaction technique(SILAR). The samples were annealed under vacuum and conductivity of the samples were taken at different temperatures. UV Spectrograph of the samples were taken and the band gap of each sample was found from the data. All the results were compared with that of the sample annealed under air. It was observed that the band gap decreases and concequently conductivity of the samples increases when the samples are annealed under vacuum.

Key words: ZnO thin film, SILAR method, Band gap.

1. Introduction

Due to wide band gap(3.37 eV) [1-4] and large exciton binding energy(~60 meV), the importance of ZnO thin films in opto-electronic devices have attracted more attention. ZnO is a promising candidate material for advanced devices applications due to the above mensioned charecteristics and unique combination of its physical properties-optical , electric, magnetic, piezoelectric and ferroelectric. Zinc Oxide is a group II-VI compound semiconductor and a large number of methods are used for the fabrication of ZnO thin film such as, sputtering, molecular beam epitaxy, metal-organic chemical vapour deposition, pulsed laser deposition etc[5-8]. Semiconducting metal oxides have been known for decades to be good gas sensing materials. Ethanol sensors based on SnO2 thick films have been commercialized for years . Thin films of ZnO are widely used in solar cells, surface acoustic wave devices(SAW), integrated optics, liquid crystal display, light emiting diode, laser diode, heat mirror coatings and recently as Solid state gas sensors. It is reported that structral, elctrical and optical properties are changed by doping with various metal ions like In,Ga,Al [2, 9, 10] etc
Though studies on dc and ac conductivity of ZnO thin films have received considerable attention, there have been only a few studies on the variation of conductivity with annealing under vacuum. In the present investigation, variation of band gap and conductivity of the samples with different annealing atmospheres is studied. The samples are annealed under vacuum and are compared with that annealed in air.

2. Experimental

ZnO thin films were prepared by successive ionic layer adsorption and reaction (SILAR) method by successively dipping the glass substrate in Sodium zincate solution and nearly boiling water. The films were deposited on a cleaned microscopic glass slide of known thickness and weight. The films thus prepared were annealed under vacuum at 400° C. for 30 minutes. The conductivity of the samples

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were taken by two probe method by placing the sample inside a PID controlled oven and consecutively heating to 210° C from room temperature. Conductivity of the samples, annealed in air and in vacuum, at different temperatures are noticed and a conductivity curve was obtained. UV spectrograph of the same same samples were taken and band gap of each sample was found from the data. The UV and conductivity data of the samples annealed in air and that annealed under vacuum are compared.

3. Results and Discussion

The following figures from fig 5 to fig 8, gives the conductivity of the samples according to annealing in air and under vacuum.

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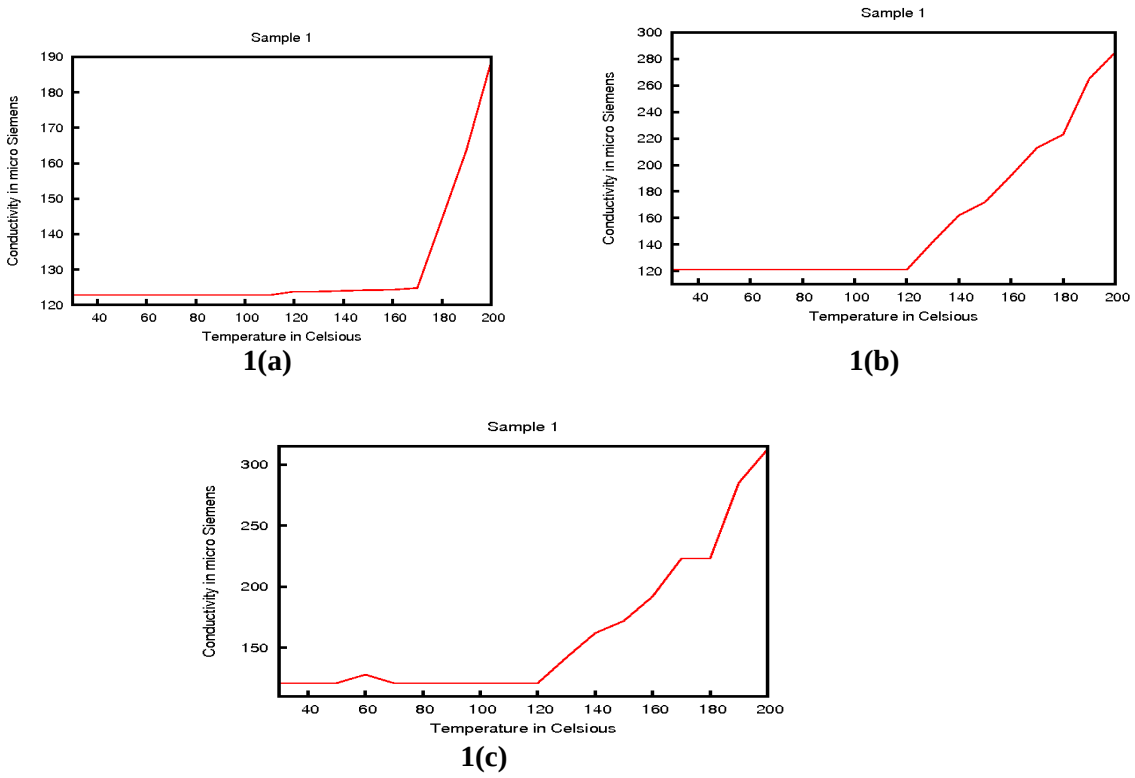

Figure 1(a-c) ***shows the (a) Sample annealed in air ,(b) annealed under vacuum at 400° C. for 30 minutes, (c) annealed under vacuum at 400° C. for 1 Hour.***

Table 1 shows the condctivity of the different samples

Name of the sample	Annealing	Maximum conductivy observed at 200 °C
Sample 1	Air	188.5 micro Siemens
Sample 2	30 min. in vacuum	285 micro Siemens
Sample 3	1 hr in vacuum	315 micro Siemens

The following figures shows the UV, and band gap graph of samples annealed in air and in vacuum respectivrly.

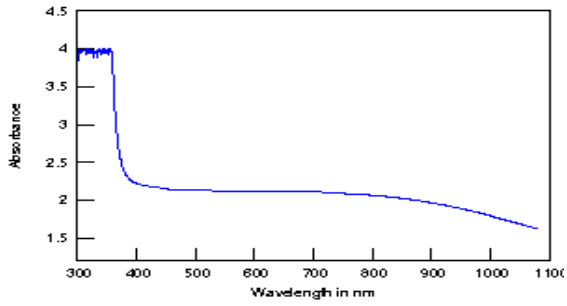

fig 2

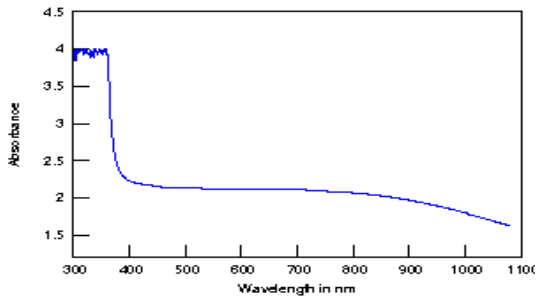

fig 3

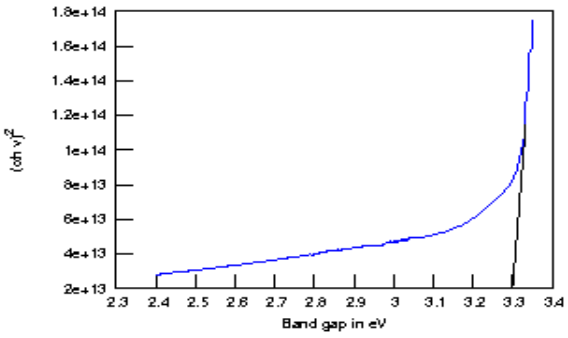

fig 4

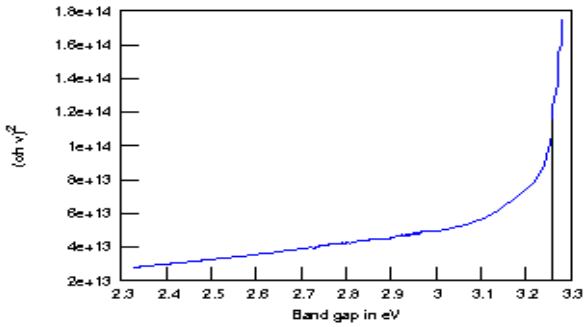

fig 5

Fig 2 and fig 3 gives the UV of the samples annealed in air and in vacuum respectively. Fig 4 and fig 5 gives the band gap of the samples annealed in air and under vacuum respectively.

Table 2 gives the Band Gap Values of the samples according to annealing.

Name of the sample	Annealing atmosphere	Band gap
Sample1	Annealed in air	3.30eV
Sample 2	Annealed under vaccum	3.26eV

4. Conclusion

Band gap in ZnO thin films prepared by silar method can be decreased by annealing the sample in vacuum instead of air. Also a decrease in band gap cause an increase in conductivity. So in ZnO thin films prepared by silar method, the conductivity of the sample incerase as the sample is annealed under vacuum.

5. Acknowledgement

Raju Mathew T is greatful to University Grants Commission for providing financial assistance for this work.

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