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ZnO Na-CMC Thin Film LPG Gas Sensor Prepared By Dip Coating Technique

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***Abstract**: In this investigation a film were prepared by sol-gel dip coating methods, using Zinc Nitrate hexahydrate (Zn (No3)2.6H2o), and organic polymer sodium carboxy methyl cellulose as base material. The film structure was analyzed by X-Ray diffractometry, and the surface morphology, were analysis and that work of art was made through scanning electron microscopy (SEM). The surface morphology is also studied with properly and finally the gas sensor tests were taken under with the closed chamber. The result showed that ZnO thin film nano particle enhanced that it have good sensing property.*
KEY WORDS: LPG sensor, Gas Sensor, Na-CMC, Thin Film, Sol-Gel.

I. INTRODUCTION

It is one of the broad studies of sensing application, it can be equipped with solo crystal micro-sized that have more powerful thin-film. It have been high sensing response to Oxidizing Reduction gases mainly the thin film depend on outer surface morphology of Semiconductor metal Oxide , The Reason for chose the dip-coating is a simple, more efficiency , dry chemical method , low cost. The general gas sensing mechanism underlying metal oxide sensor function involves a resistance change through a reaction between the oxygen species (O−2, O2−2, O2−) chemisorbed onto the metal oxide surface and the target gas molecules. Under ambient air conditions, the surface of a metal oxide material is covered with charged oxygen species that accept charge carriers (electrons) to form a depletion region on the surface[1,2]. As these species react with reducing agents, oxygen species are desorbed from the surface and release the trapped electrons, which reduce the film thickness in the depletion region and, consequently, the resistance. Which is leads to its application in numerous fields. Nowadays use of nano materials in the field of gas sensor has gained interest as it helps in detection of toxic and combustible gases [3,4].

II. MATERIAL AND METHODS

4.68grm of Zinc Nitrate hexahydrate solution was prepared by using 150ml of di-water with stirring for 60min That both mixing solution act as an originated solution. Take 2.5gms of Na-CMC is dissolved in 200ml of di-water with 50°c temperature for this dissolved solution act as a thickening agents, and then the originated solution is added slowly to thickening agent at the flow rate of 1ml/min, and finally a white viscous solution is obtain during the entire process temperature are also maintained at 70°c. For dip-coating we used the cleaned substrate by adding chromic acid +di-water 150ml for 40min on beaker, then cleaned the substrate with acetone, sodium hydroxide, Iso-prapol alcohol, by using cotton balls.

III. RESULTS AND DISCUSSION

3.1 XRD Patterns of Zno Thin Films

Shows the XRD pattern of ZnO Thin film annealing at 450°c and 500°c .The detected (h l k) peaks are at 2θ values of 31.32°, 34.47°,36.09° corresponding to lattice planes (100), (002), and (101) respectively. And for 500°c The detected (h l k) peaks are at 2θ values of 31.10°, 34.16°,36.01° corresponding to lattice planes (100), (002), and (101) respectively. They are agreement with the standard JCPDS 036-1451 Card for hexagonal wurzite ZnO.

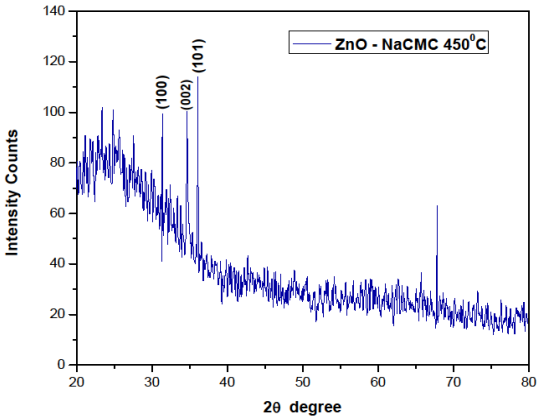

Fig.1. XRD pattern for ZnO thinfilm 450°c

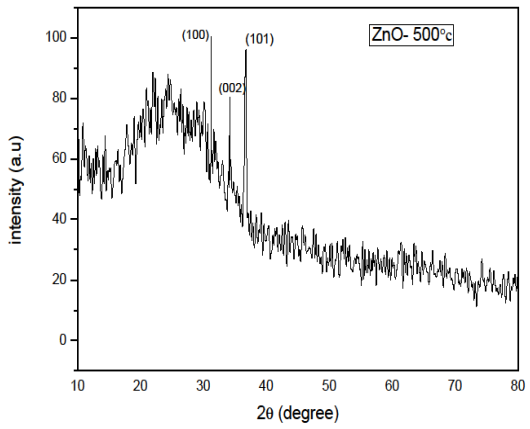

Fig.2. XRD pattern for ZnO thinfilm 500°c

3.2 Fe-Sem Image

The surface morphological and elemental compositions analysis of the prepared sample was studied

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using Field emission scanning electron microscope. FE-SEM image of ZnO sample shows the observation of ZnO nanorods it shoes the large quantity of nanorods and also has needle type structure.

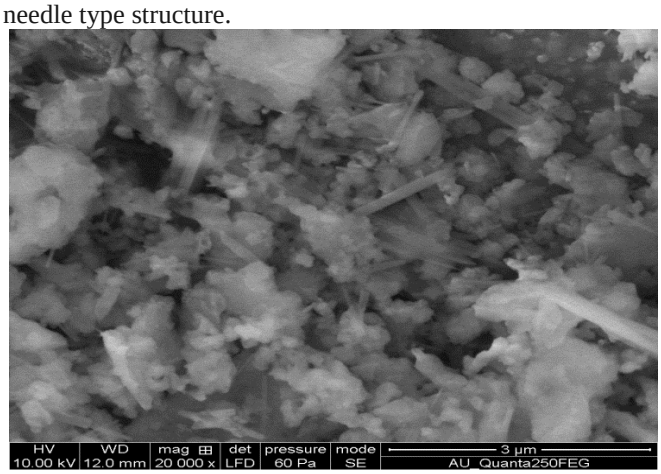

Fig.3. FE-SEM image for 450°c

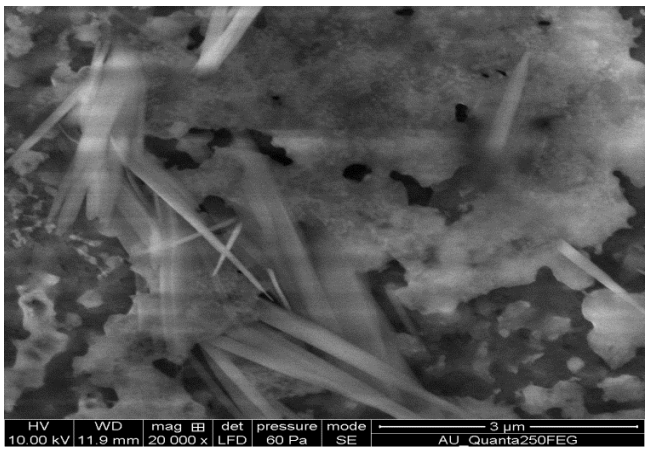

Fig.4. FE-SEM image for 500°c

TABLE-1 DIP Coating Machion Slide Setup Proces

SNO	WORKING SETUPS	TIME/SIZE
1	STARTING POSITION	30mm
2	DIP LENGTH	120mm
3	DIP SPEED	3mm/sec
4	RETURN SPEED	9mm/sec
5	DIP DURATION	30 sec
6	DRY DURATION	1min
7	NUMBER OF DIPS	10 dips

The above mentioned process were repeated for 40 times for uniform coating and dried at 50°c with automatic drying dip-coating machine. After the coated films were dry, it could be taken for annealing at 450^0c, 500^0c, for 3 hours to get crystalline ZnO nano-particles of thin films.

3.3. Gas Sensors

The sample could be test with the closed chamber of 50ppm LPG is injected, due to the reducing nature, gas tends to release the trapped on ZnO thin film surface. The decrease in high potential barrier conduction increased. This causes resistance to fall from base resistance. This possible chemical for acetone is as follows [5,7]

TABLE-2 Gas Sensing

Prec	Features nm	Form	Gas	Ppm	Sensor type	R
450^0c	60L	Film	LPG	50	Ω+0 SNO	31.3
500^0c	200L	Film	LPG	50	Ω+0 SNO	48.2

c - precursors, Tdep - temperature of deposition, Top: operating temperature,

tres: response time, ppm: partsper millon, R = Ra/Rg (oxidative gas),

R = Rg/Ra (reductive gas) [7,9]

From the observation that lower detection limit of annealed ZnO thin film was 50 ppm and its response was found s=31 very low response 1ppm was due to very few acetone molecules for interaction. The very high response of 50ppm concentration has been shown in below table.

IV. CONCLUSION

The fabricated is prepared by sol-gel dip coating technique and its gas sensing characteristics were studied. Crystallinity and the existence of most stable wurtzite structure were confirmed with XRD. The sensing test was carried out in a closed chamber using chemiresistive method at room temperature. The test result showed that the fabricated ZnO thin film can act as LPG sensor. The lowest detection limit of room temperature ZnO thin film was observed to be 50 ppm of LPG gas with the response of 31secs for ZnO thin film annealed at 450°C.

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