iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** II **Month of publication:** February 2020

DOI: http://doi.org/10.22214/ijraset.2020.2050

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 8 Issue II Feb 2020- Available at www.ijraset.com

Zno Thin films as an Anti-Reflection Coating on Solar Cells

R. D. G Bhavani[1], K. Rama Sudha[2], R. Vijay Shanthi[3]
[1]*PG Scholar, Dept. of Nano Technology, AUCE (A), Andhra University, Visakhapatnam, AP, India*
[2]*Professor, Dept. of Electrical Engineering, AUCE (A), Andhra University, Visakhapatnam, AP, India*
[3]*Asst.Professor, Dept. of Electrical Engineering, AUCE (A), Andhra University, Visakhapatnam, AP, India*

Abstract: ***Zno thin films are prepared by sol-gel method using zinc acetate dehydrate [$Zn(CH_3CO_2)_2.2H_2O$] and isoproponal. Di-ethanol amine is added as a stabilizer. The soluation was stirred for 90min at 600^0c using sol-gel. The thin films are fabricated on glass substrates at different durations at 40sec, 50sec & 60sec by adjusting the speed at 3000RPM. The films showed a bandgap of 3.49 to 3.64ev corresponding to speed and durations of spin coater.***

I. INTRODUCTION

A solar cell is a device which converts the energy form sun into electrical energy. Silicon is a semi conductor optical material with relatively index. It is an ideal material for solar cells. When the light is incident on a solar cell about 35% of the incident light is reflected back. In general, the optical losses account for about 7% efficiency loss in crystalline silicon solar cells.

The anti-reflection coating on the solar cell reduces the optical losses such as reflectance and increase the efficiency. The bandgap determines the wavelength at which photovoltaics operate more efficiency. generally we use wide bandgap semiconductor materials as an anti-reflection coating on the solar cells. In this work we will see how Zno can be used as an anti-reflection coating on the solar cells.

II. EXPERIMENTAL DETAILS

A. *Materials Required*

4g Zinc acetate dehydrate , 50ml iso propanol, 4ml diethanolamine

B. *Sol-gel Method*

1) Synthesis of ZnO solution : Initially, 4 g of ‘‘Zinc acetate dehydrates” in the 50 ml of ‘‘iso propanol”. Then this solution was stirred with the help of magnetic stirrer at 60degree celciusfor 30 min. After that the ‘‘di ethanol amine” as a stabilizer was added in this solution and stirred the solution for 90 min at the temperature of 60degree celcius. The clear homogeneous solution of ZnO was obtained by aging this solution for 24 h.
2) Coating of Zno precursor solution on substrate: Now the glass substrateis fixed on spin coating system and its disc speed is adjusted at 3000 rotation/min. The rotation time is 30 s per sample. The drops of sol-gel solution are dropped on the glass substrate as per requirement of layers. After 30 s, the glass substrate is removed from spin coating disc and placed on the hot plate for almost10 min to dry at 100degree celcius. The experiment is repeated to make thin films with multilayer. The thin films are put in Furnace and the temperature is raised gradually until the temperature reached 400degree celcius. Then the furnace is switched off and each sample is left to cool down until it reaches room temperature. Then samples are taken from the furnace and now they are ready to analyze.

III. RESULTS AND DISCUSSIONS

A. *Thin Film Thickness Measurement system*

The thin film thickness measurement was done to glass slide coated with Zno and the thickness of the coating is measured. The table below shows the values of thickness of the coating deposited on the glass surface at different speeds and duration.

Speed	Wavelength	Thickness
40s	408 nm	79.66 nm
50s	420 nm	84.41 nm
60s	400 nm	78.36 nm

Table 1: Thickness of Samples at different speeds.

B. UV-VIS-NIR Spectroscopy

The UV-VIS-NIR Spectroscopy was carried out on the Zno coated glass slide and the values of the wavelength at which the absorption peak occurred has been noted. The bond gaps were also calculated for the same by using the formula. E=hc/λ Where E=band gap, h=Planck's constant, λ =wavelength at which the absorption occurred.

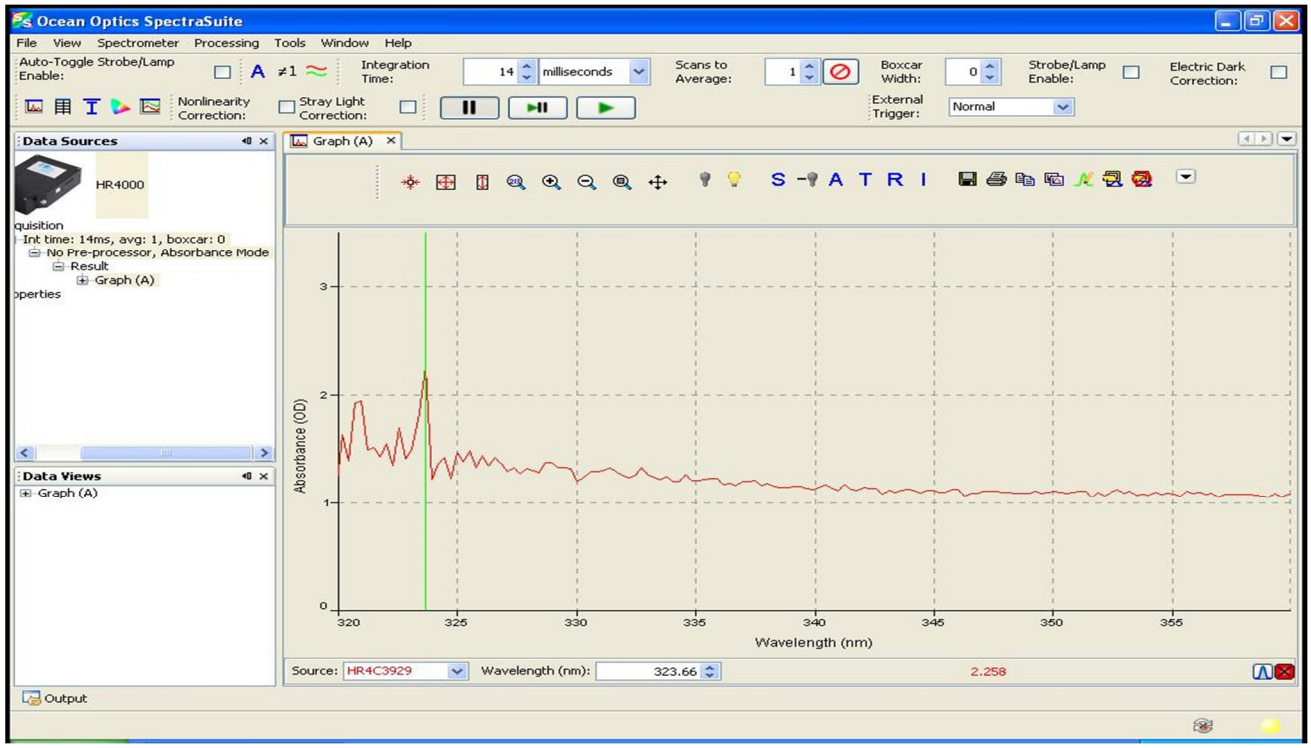

FIG 1 : graph at 60sec, 3000RPM

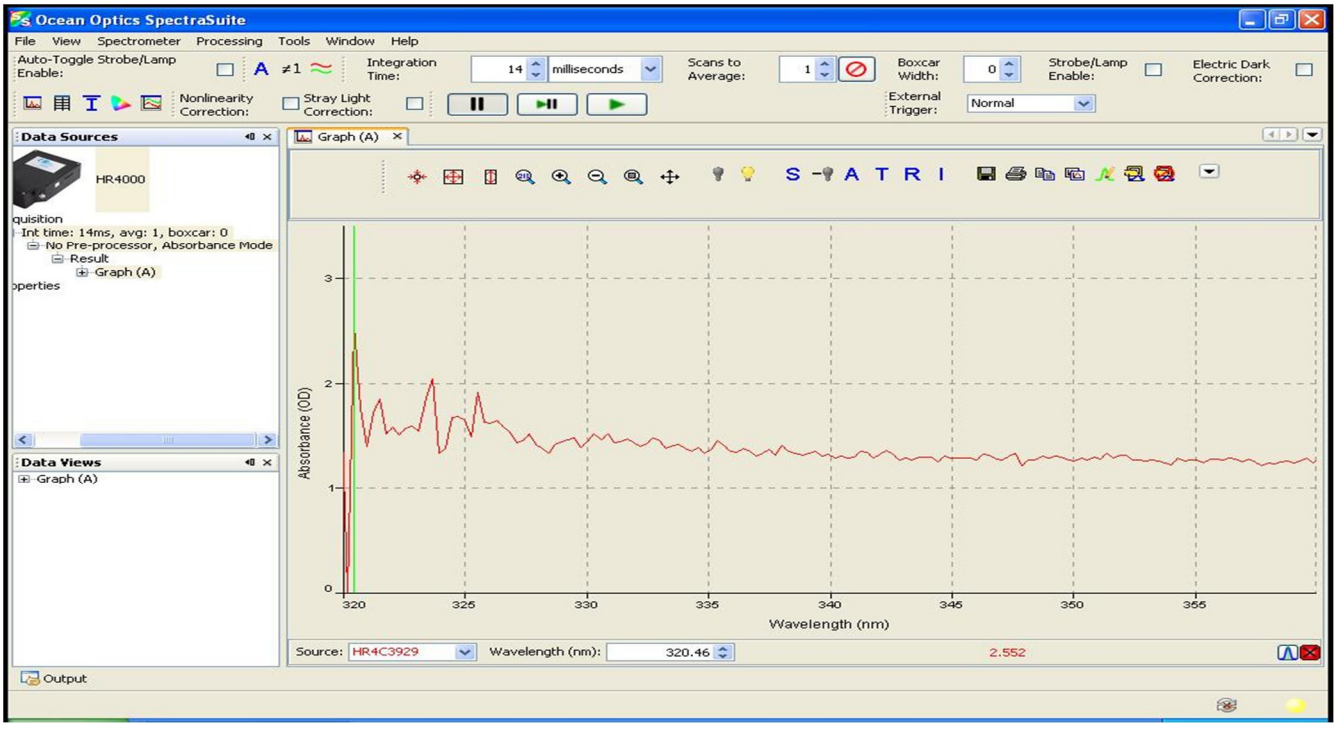

FIG 2 : graph at 50sec, 3000RPM

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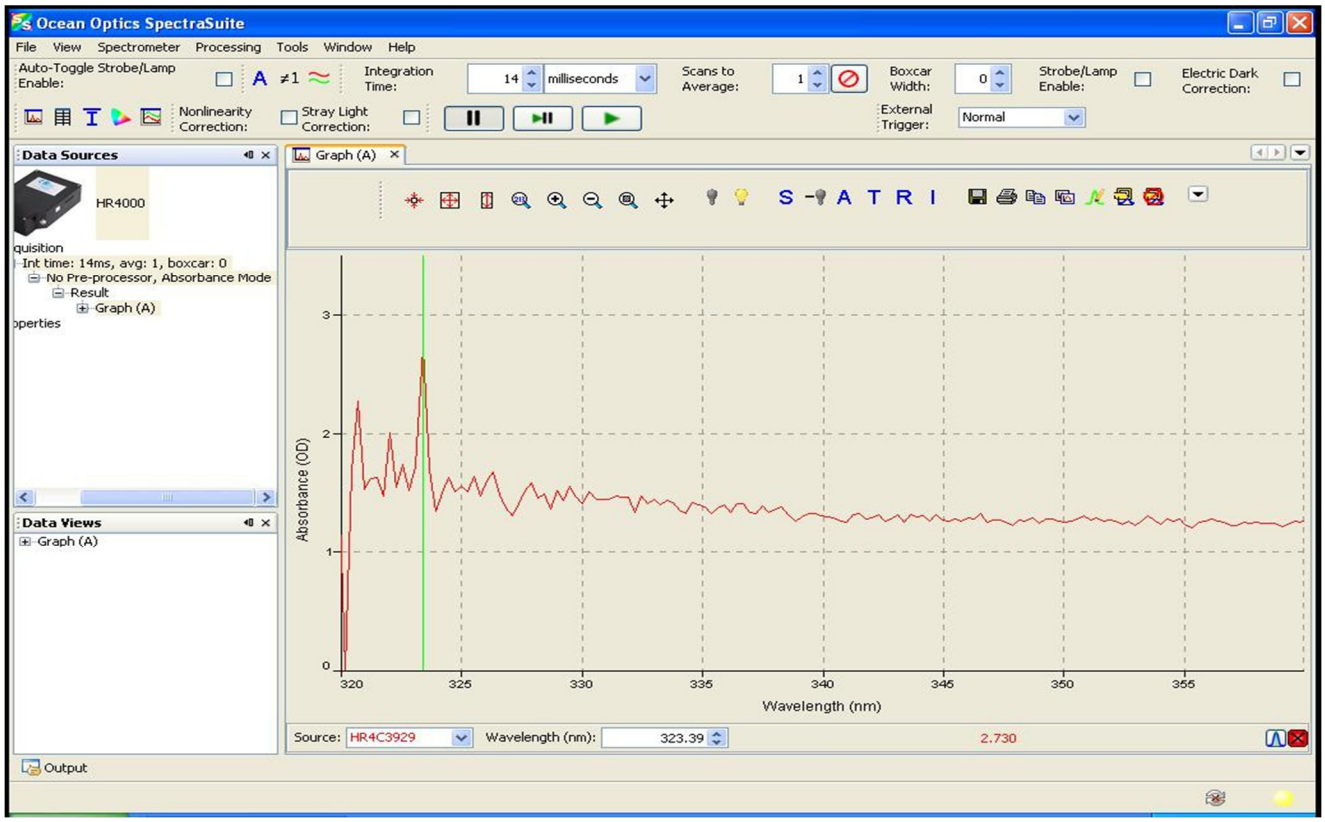
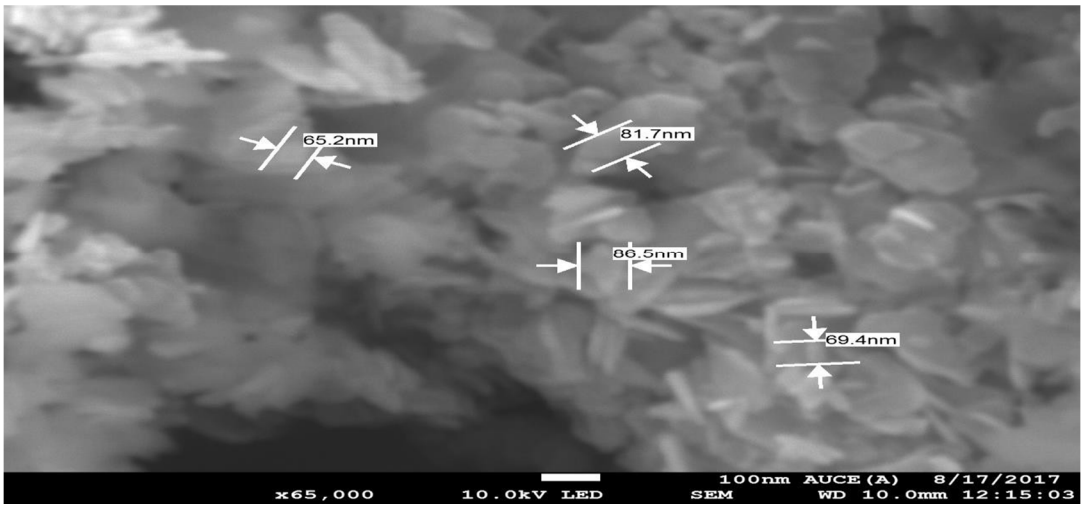


FIG 3 : graph at 40sec, 3000RPM

Duration	Wavelength	Bandgap
40s	340.79	3.645ev
50s	341.53	3.630ev
60s	354.83	3.49ev

C. FESEM Result



FESEM image of Zno

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IV. CONCLUSION

Zno thin films were fabricated by using sol-gel spin coating method at 400^0c for different speeds such as 3000RPM and durations of 40sec, 50sec, 60sec. The thickness of the film is measured using thin film measurement system. The thickness was found to be in the range of 84.41 nm to 78.36 nm. The UV-VIS-NIR Spectroscopy was done and band widths were in the range of 3.41 to 3.645. The FESEM characterizations are also done. Hence we can conclude that due to the wide optical band gap and low absorption i.e high transmittance in the visible region the Zno can be used as an anti reflection coating application for the photovoltaics.

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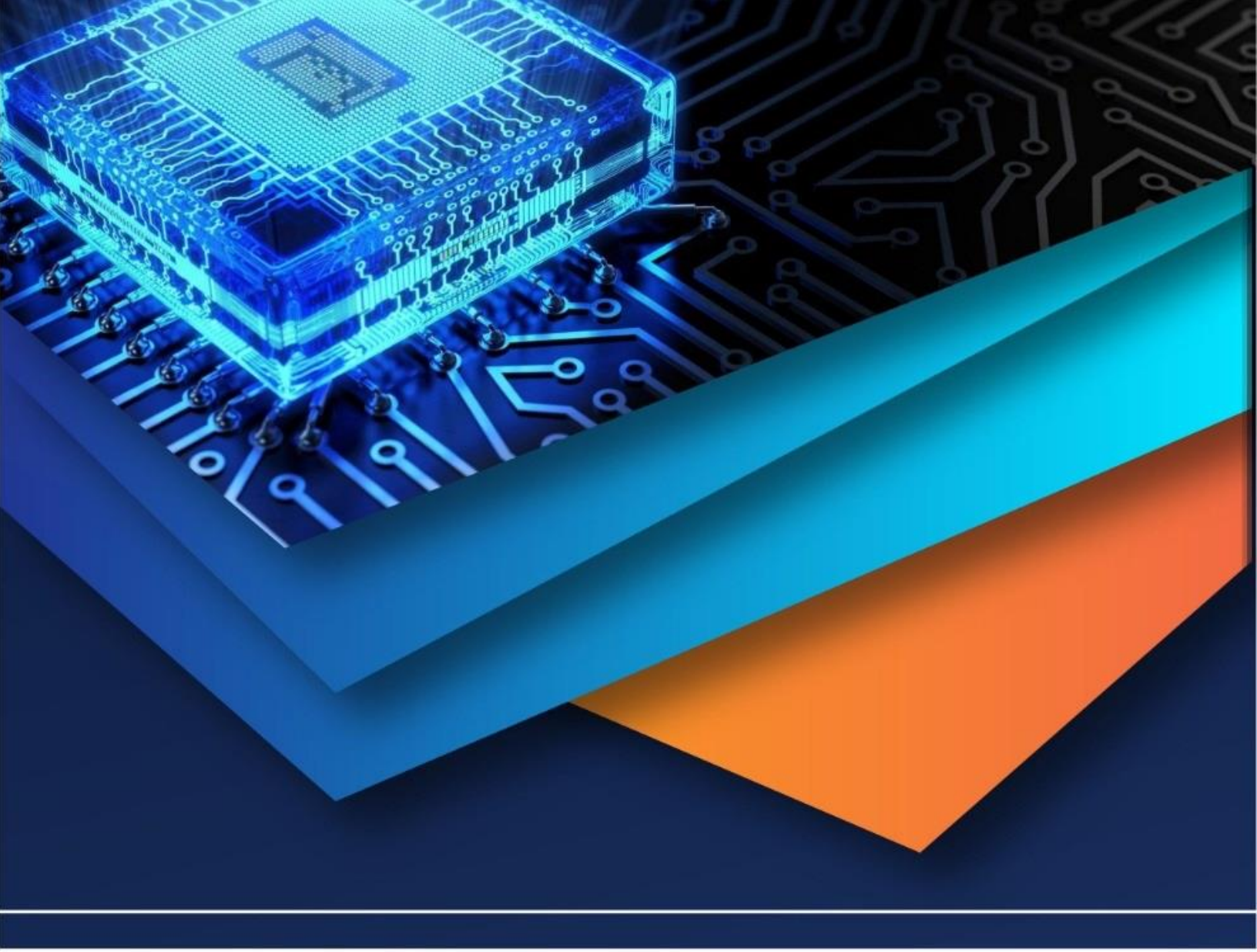

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