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Effect Of Film Thickness On The Transmittance Of Chemical Bath Deposited Barium Sulphide (BaS) Thin Film

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Abstract: Effect of Film Thickness on the Transmittance of Chemical Bath Deposited Barium Sulphide (BaS) thin film was investigated in this paper. The films of different thickness were deposited on glass substrates for different dip times, 12hrs, 24hrs, 36hrs, and 48hrs. Optical characterization of the films was carried out using UV752 spectrophotometer. The results revealed that the films have good transmittance in the range of 0.989-0.991. The film with the highest thickness of approximately t = 2.360µm has high transmittance of 0.991 while the film of lowest thickness of approximately t = 2.212µm has transmittance of 0.968. The thickness of the film was observed to increase as the dip time increases.

Keywords: Thin films, chemical bath deposition, film thickness, transmittance.

I. INTRODUCTION

Thin film materials are the key elements of continued technological advances made in the fields of optoelectronic, photonic and magnetic devices. In thin film technology, industrial requirements are supported by selecting coatings, materials and thickness of films[1]. Therefore to perform the function for which they are designed, thin films must have the proper thickness, composition, roughness and other characteristics important to the particular application[2]. Barium sulphide thin film is a semiconductor that belongs to the metal chalcogenides group and can be synthesized using various deposition techniques such as spray pyrolysis[3], elecctrodeposition[4],successive ionic layer adsorption and reaction[5]-[6], and chemical bath deposition[7]. In this research the BaS films were deposited using the chemical bath technique and different film thickness was obtained by four different dip times 12hrs, 24hrs, 36hrs and 48hrs.

II. EXPERIMENTAL PROCEDURE

BaS films were grown at room temperature by chemical bath deposition technique. The glass substrates and beaker were initially washed using mild detergent after which they were thoroughly rinsed with distilled water and air dried. After the treatment, 5ml of 0.1M solution of $BaCl_2$ was put into the reaction bath (50ml beaker) followed with the addition of 5ml of 0.1M ethylene diamine tetra acetic acid (EDTA) as the complexing agent. The solution was stirred for 3minutes to ensure uniform mixture before the addition of 5ml of ammonia solution and 5ml of 0.1M thiourea. About 30ml of distilled water was added to make the solution up to 50ml of the bath and the solution was again stirred before the substrate was immersed vertically in the bath. Three other baths were set up in this manner and allowed to stand for different interval of time in order to obtain different thickness for the films. The first slide stood for 12hrs, the second slide 24hrs, third slide 36hrs and fourth slide 48hrs. At the end of the depositions, the substrates were carefully removed, rinsed with water and allowed to dry in the open air. The deposited films were characterized optically using UV752 spectrophotometer. The reaction mechanism is of the form:

$BaCl_2.2H_2O + EDTA \rightleftarrows [Ba(EDTA)]^{2+} + 2HCl + 2OH^-$

$[Ba(EDTA)]^{2+} \rightleftarrows Ba^{2+} + EDTA$

$CS(NH_2)^2 + OH^- \rightleftarrows CH_2N_2 + H_2O + HS^-$

$HS^- + OH^- \rightleftarrows S2^- + H_2O$

$Ba^{2+} + S^{2-} \longrightarrow BaS$

III. RESULTS AND DISCUSSION

The four samples of the deposited films were used in the analysis because of the smooth adhesion of the films to the substrates.

A. FILM THICKNESS VARIATION

The thicknesses of the films in this research were obtained by varying the dip times of the four samples and calculated using the formula

$$t = -\frac{\ln(T)}{\alpha} \qquad 1.1$$

Where T = transmittance (in a.u) and α = absorption coefficient. The values reveal that the thickness increase as the dip time increases (Fig 1). This result is consistent with that obtained by Okoli (2015)[8].

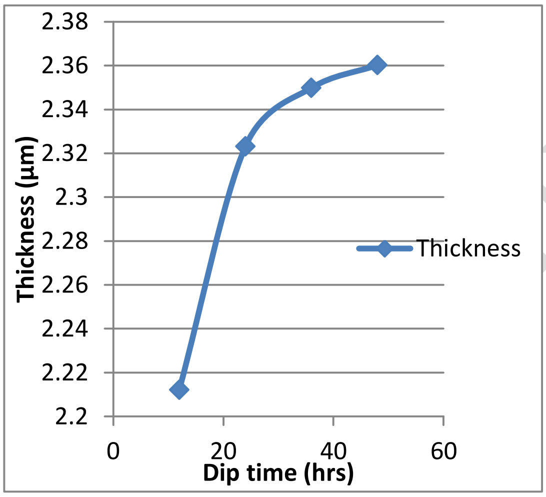

Figure 1: Plot of film thickness against dip time

B. OPTICAL TRANSMITTANCE

The optical transmittance of the BaS thin films were observed with a spectrophotometer in the wavelength range of 200nm-700nm. All the films show high transmission of solar radiation as shown in fig 2. The transmittance is relatively low in the uv region for all the samples but samples 1(12hrs) and 2(24hrs) have the least transmittance in the uv region. The transmittance in the visible region is high and samples 3(36hrs) and 4(48hrs) have higher transmittance than samples 1(12hrs) and 2(24hrs). From this experiment, one can infer that the transmittance of the thin films were sensitive to the film thickness. Transmittance spectra of the films increase as the thickness increases. This implies that the dip time affects the transmittance.[9]

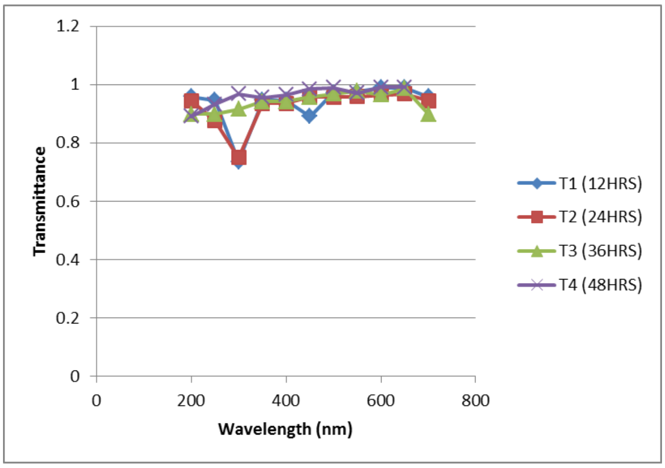

Figure 2: Transmittance spectra of BaS thin films

Sample 4 (48hrs) with highest film thickness of approximately t = 2.360µm show high transmittance of 0.991 while sample 1(12hrs) with the lowest film thickness of approximately t = 2.212µm has transmittance of 0.968.

As a result of the high transmittance of the films, they exhibit very poor reflectance in the range of 0.005-0.067 particularly for samples 3(36hrs) and 4(48hrs) as shown in Fig 3 below. This unique characteristic makes Barium sulphide very useful in applications such as solar energy collector, antireflection coating and photosynthetic coatings.

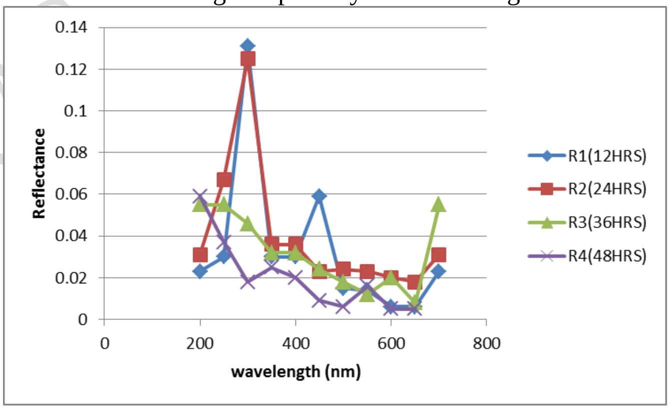

Figure 3: Reflectance of BaS thin films

IV. CONCLUSION

In summary, we successfully deposited good thin films of BaS using chemical bath deposition technique on glass substrates. Different film thickness was obtained by varying the dip times. The transmittance of the films was measured by UV752 spectrophotometer and was observed to be sensitive to film thickness. Film with highest thickness of approximately t =2.360µm showed the highest transmittance of 0.991.

REFERENCES

[1] Oloomi, S. A. A., Saboonchi, A., Sedaghat, A. (2010). Effect of thin film thickness on emittance, reflectance and transmittance of nano scale multilayers. Int.J.Phys.Sci., 5, 465-469.

ISSN: 2394-4404

[2] Fukkao, N., Kyung, K., Shiratori, S. (2011). Automatic Spray-LBL machine based on in-situ QCM monitoring, ACS pub. Macromolecule, 44, 2964-2969.

[3] Onyia, A. I., Okeke, C. E. (1989). Fabrication and Characterization of tin oxide (SnO_2) thin films using simple glass spray system. J.Phys.D: Appl Phys., 22, 1515-1518.

[4] Osaka, T. (2000). Electrodeposition of highly functional thin films for magnetic recording devices of the next century. Electro. Acta, 45(20) 3311-3321

[5] Sartale, S. D., Lokhande, C. D. (2000). Deposition of cobalt sulphide thin films by successive ionic layer adsorption and reaction (SILAR) method and their characterization. Ind.J.Pur.Appl.Phys., 38,48-52.

[6] Gulen, Y. (2014). Characteristics of Ba-Doped PbS thin films prepared by the SILAR method. APhys.Pol A, 126, 763

[7] Joshi, R. K., Aloke, K., Schgal, H. K. (2004). Appl.Surf.Sci., 221, 43-47.

[8] Okoli, D. N. (2015). Optical properties of Barium sulphide thin films prepared by chemical bath deposition technique. J.of App.Phys., 7, 10-15.

[9] Nnabuchi, M. N. (2006). Structural and optical characterization of BaS thin films grown by solution growth technique. J.Res.Sci., 17(4) 263-271.