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DEVELOPMENT OF LITHIUM TANTALITE ($LITAO_3$) FOR AUTOMATIC SWITCH ON LAPAN-IPB SATELLITE INFRA-RED SENSOR

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Abstract

Automatic switch is a deadly being animate or automatically an electrical device that use the technology sensors to detect movement, or body temperature that was detected in the switch. The sensor use is the passive infra-red receiver (PIR) by using lithium tantalite ($LiTaO_3$) that would have capturing a moment in response temperature change. In this research, it has synthesized a thin film of lithium tantalite ($LiTaO_3$) on a substrate silicon p-type. The film is produced by *chemical solution deposition* (*CSD*) and engineering spin coatings and temperature annealing on 550°C, 600°C, 650°C, 700°C, 750°C and 800°C. Setting up the speed and 3000 rpm is 30 seconds. The value of high absorbent show that the $LiTaO_3$ film has a large number of energy of the photon. This research obtained the energy band-gap film $LiTaO_3$ in the range 3.41-4.56 eV. The results concludes that the affect of temperatures annealed the optical properties of the film $LiTaO_3$ as the substrate of Si (100) p-type semiconductor. The sensitivity of high intensity absorbent for energy and high value of band-gap is great and potential to be used prospectively for the automatic switch sensor on the satellite platform.

Keywords: $LiTaO_3$; semiconductor; automatic switch sensor; Lapan-IPB Satellite (LISat)

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1. Introduction

Facing technology era recently, it is prosecuted and encouraged to more creative to make a simple instrument and environmental friendly to. Switch automatically is a tool that animate or deadly automatically an electrical equipment technology that uses sensors to detect movement, or body temperature should be installed in the switch. The Sensor is a PIR (Passive Infra-Red Receiver) to using material of $LiTaO_3$ possesses a momentary response to changes in body temperature.

Lithium tantalite ($LiTaO_3$) constitutes the materials ferroelectric, material having the nature of piezoelectric and pyro electric and have the nature of electro-optic and coefficients is non-linear of optics.[2,4] $LiTaO_3$ is a material having the constant dielectrics high, and storage capacity of charge.[7] $LiTaO_3$ is crystalline ferroelectric who subjected to the process of temperature Currie higher by (601$\pm$ 5,5) °C.[8]

On this research growing film lithium tantalite ($LiTaO_3$) made by using a method of chemical solution deposition (CSD) with technique coatings. Spin Excellence this method can control stoichiometric move with a good quality, procedures that easy conducted at low temperatures and cost relatively economical.[5,9] Some method can be used for growing film of them chemical vapor deposition (CVD) pulse laser ablation deposition (PLAD) solution gelatin (sol-gel) metal organic chemical vapor deposition (MOCVD) and sputtering.[10,19]

2. Experimental

An undersize Si (100) substrate is 1 cm x 1 cm must be clean by the stage process of leaching and the substrate soaked by deionized water for 10 minutes and drained. The drained-substrate soils on surface of a hot plate with temperatured 100°C for 1 hour. A film was made by the $LiTaO_3$ powder (tantalum oxide of lithium acetic) and powdered with 2.5 ml dissolved 2-metoxiethanol.[18] Growing $LiTaO_3$ film on the surface of reactor using methods CSD spin coater at the speed of 3000 rpm.[9,11] The film growth $LiTaO_3$ as follows: that has been cleared, the substrate laid on the surface record spin reactor coater then closed 1/3 spare-parts with adhesive. Part 2/3 substratum solution $LiTaO_3$ by one drops with 3 times test every 30 seconds. After that of the substrate heated to evaporate hot plate on the surface of the fluid.[6,16]

The process of annealing aims to diffuse $LiTaO_3$ solution to the substrate of silicon .The process of annealing done gradually uses 3-130 Vulcanite ™ furnace.[20] Warming starts from the room temperature and then raised until the temperature of an annealing desired namely 550°C, 600°C, 650°C, 700°C, 750°C and 800°C held constant for eight hours. Film $LiTaO_3$ after the process of annealing calculated its thickness with the methods volumetric.[13] the next process is making contact on film measures 1 mm x 1 mm using aluminium 99.99 %. Then the installation of copper wire smooth using a paste of silver on contact. Characterization optical properties using spectrophotometer UV-Vis ocean optics USB 1000.[14,15]

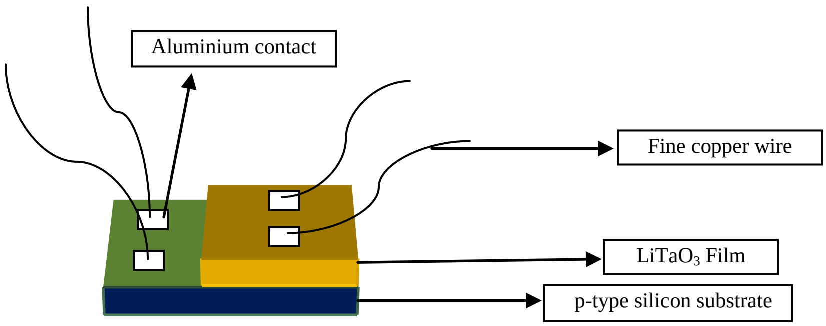

Fig. 1 Design of $LiTaO_3$ ferroelectric

3. Result And Discussion

3.1. The Thickness of Film

The thickness of $LiTaO_3$ film after the annealing process of an annealing is showed by Table 1. The thickness of film volumetric calculated by the equation (1).

$$d=\frac{m_2-m_1}{\rho_{film}\cdot A} \tag{1}$$

Table 1 $LiTaO_3$ after the process of annealing

No	Sample film Temperature (°C)	Thickness d (cm)
1	550	1.34×10^{-4}
2	600	6.97×10^{-4}
3	650	5.36×10^{-4}
4	700	1.74×10^{-4}
5	750	4.29×10^{-4}
6	800	6.17×10^{-4}

The thickness moves in ranged 1.34-6.97 µm. It is in the same range the literature where using the same method (1-400 µm).[12]

3.2. Absorbance Characterization

The value of high absorbent shows that the film $LiTaO_3$ many absorbs energy of photons hits the film. Figure 1 shows absorbency relations and wave length of $LiTaO_3$ film after the annealing process.

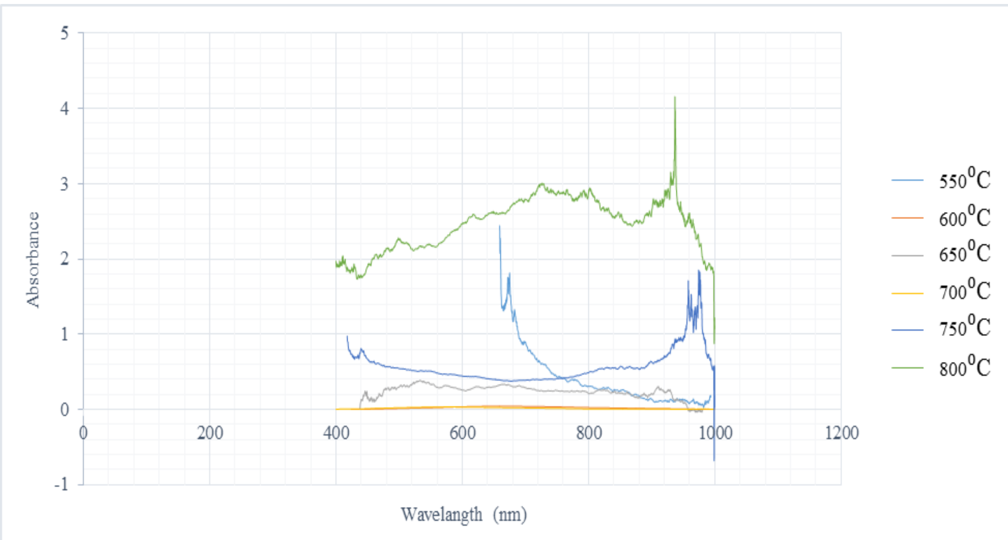

Fig. 2 Absorbance relations and wavelength $LiTaO_3$ film after the annealing process

The absorption of photons by materials can occur by sundry ways. Process and absorption against wavelength give the possibility to degrade chemical information regarding the material through reflected light. The value of high absorbent show that $LiTaO_3$ film reached the temperature 800^0C. Absorbent wavelength is in range 400-1000 nm. Medium indigo absorbent $LiTaO_3$ on infra-red wavelengths.

3.3. Reflectance Characterization

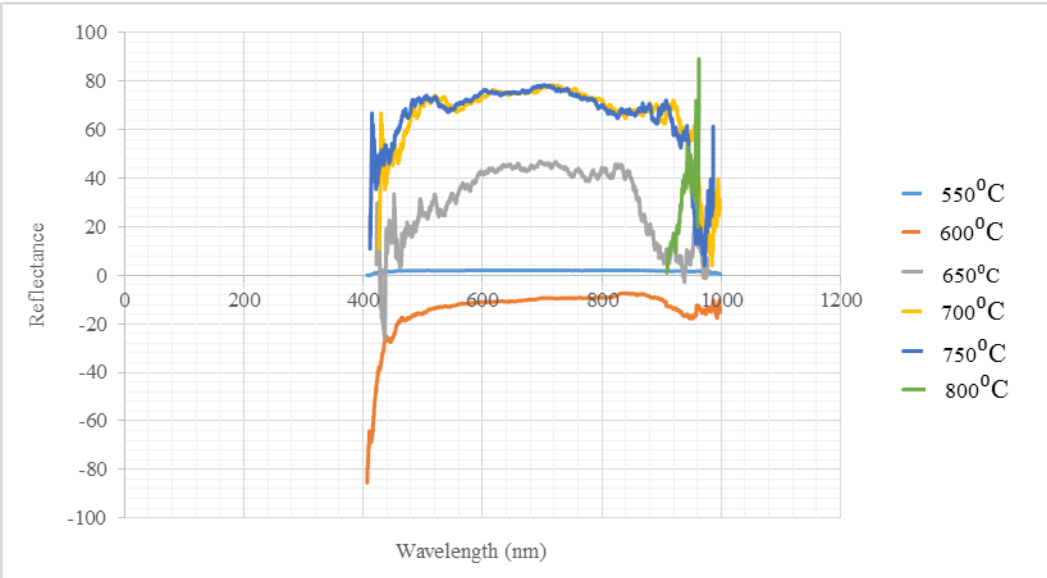

Fig. 3 Reflectance relations and wavelength film-business $LiTaO_3$

The value of a maximum and minimum reflectant produced different layers for each with the annealied thickness according the variations of temperature. Figure3. Showed that each annealed-temperature, can be seen the wave fluctuation appeared reflectant shifting and showed a declining value of the annealed-temperature 550^0C. The lower reflectant can be caused by the size of large granules .The large granules having large internal absorption of photons lasting follow the law of beer-Lambert. The value of high reflectance show that the film $LiTaO_3$ to temperature 500^0C. Reflectant is the opposite of absorbent shoed in Figure 3.The relationship between reflectance and wavelength in range 400-1000 nm.

3.4. Energy Band-gap

Band-gap energy is able to calculate by using a reflectance calculation. Calculation value of the band-gap energy by equation (2).[17]

$$2\alpha d = [(R_{max}-R_{min})/(R-R_{min})]^2 \quad (2)$$

Reflectance calculation of band-gap energy was obtained by extrapolating $[\ln(R_{max}-R_{min})/(R-R_{min})]^2$ to 0, by the x-axis is hv and the y-axis is $[\ln(R_{max}-R_{min})/(R-R_{min})]^2$.

Table 2 Energy *band-gap* $LiTaO_3$

No	Sample film Temperature (°C)	Energy *band-gap* (eV)	*Band-gap* $LiTaO_3$ (eV), Youssef et al, 2008
1	550	3.61	4,6
2	600	4.45	
3	650	3.41	
4	700	4.10	
5	750	4.32	
6	800	4.56	

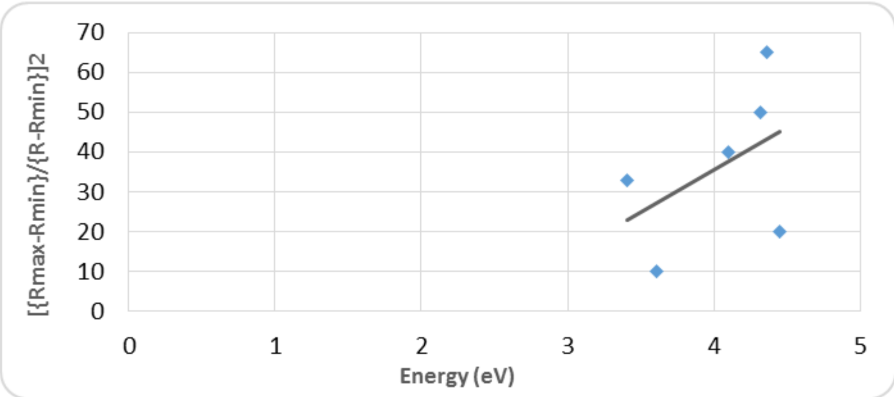

Fig. 4 Energy band-gap film $LiTaO_3$ after the process of annealing

The proviouse research obtained band-gap value between 3-4.6 eV.[18] while, band-gap energy of $LiTaO_3$ was obtained in range 3.41-4.56 eV as showed in Table 1. By the value seems that the band-gap energy obtained, $LiTaO_3$ film as a semiconductor based on literature (1-6 eV).[20]

Conclusion

Based on the results of the study concludes that the affect temperatures annealed optical properties of $LiTaO_3$ film from Si (100) p-type substrate semiconductor. Band-gap energy of $LiTaO_3$ film obtained the the range of 3.41-4.56 eV. Sensitivity of high absorbant intensity obtained for energy and high value of band-gap are great and potential prospectively to be used for the automatic switch sensor on the satellite.

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